No 2700 VOLUME 78 FRIDAY 9 DECEMBER 1960

FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

Official Organ of the Royal Aero Club First Aeronautical Weekly in the World Founded 1909

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Iliffe Transport Publications Ltd, Dorset House, Stamford Street, London SE1: telephone Waterloo 3333. Telegrams Flightpres Sedist London. Annual subscriptions: Home £4 15s. Overseas £5. Canada and USA $15.00. Second Class Mail privileges authorized at New York, NY.

Branch Offices Coventry: 8-10 Corporation Street; telephone Coventry 25210. Birmingham: King Edward House, New Street 2; telephone Midland 7191. Manchester: 260 Deansgate 3; telephone Blackfriars 4412 or Deansgate 3595. Glasgow: 62 Buchanan Street C1; telephone Central 1265-6.

New York, NY: Thomas Skinner & Co (Publishers) Ltd. 111 Broadway 6; telephone Digby 9-1197.

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Engines Particularly

ABOUT a year has passed since Frank Beswick concluded his notable series of interviews on *Flight's* behalf with leading figures in the aircraft industry. This week he is back for another run over the target, with his sights set on the Minister of Aviation himself. Discussing exports, the Minister remarks: "The industry has done well, magnificently well, and on engines particularly."

This special commendation for the engine builders comes as an official benison on a recent celebration in London to mark the sale of over 1,000 civil aircraft powered with Rolls-Royce gas turbines. The tremendous contribution to our national prosperity made by this one great engine company is perhaps best illustrated by the fact that of about 1,760 civil aircraft with turbine engines sold to date in the Western World, well over half—nearly 60 per cent in fact—have their powerplants hallmarked with the two Rs.

On the occasion referred to above Mr J. D. Pearson, Rolls-Royce chief executive and deputy chairman, announced the name "Spey" for the RB.163 engine now under development for the de Havilland Trident—an especially happy choice having regard to the very large Scottish element within Rolls-Royce. The name suggests a suitable libation to the first thousand Rolls-Royce-turbine-engined airliners—and perhaps another to the second thousand. Mr Pearson, however, was constrained to remark: "Selling engines for the next thousand is going to be difficult." Changing circumstances in the world aero-engine industry, he said, had sharpened competition into something approaching a fight for survival. At the same time, changed circumstances of the industry in this country posed great problems in financing the development of future engines. Mr Pearson did not think it was generally known that the development and launching costs of a modern large aero engine were about twenty million pounds—about equal to those of the airframe in which it would be fitted. Clearly such an investment was unlikely to be recovered from a single aircraft project, which emphasized the importance of harmonizing civil and military requirements. Rolls-Royce now found themselves completely dependent on Government support for the development of future engines. The amount of that support, it was hoped, would be the same as that accorded by the US Government to Rolls-Royce's main American rivals.

Negotiations are under way, the outcome of which seems hopeful. Whatever the result, Rolls-Royce do not approach the Minister cap in hand.

Little Aeroplanes and the RAF

THE need of the Royal Air Force to recruit 50 per cent more pilots and navigators than at present, and the part which the flying clubs could play towards this, were among the major points emphasized by the Air Officer Commanding-in-Chief of Flying Training Command at the Association of British Aero Clubs dinner reported in this issue. Of the three thousand cadets who had gained flying scholarships since the scheme began in 1950, said the AOC, over 1,100 had become RAF aircrew; and the wastage rate of scholarship-holders was only one-sixth of the rate for those with no such training. For the future, the RAF's problem remained that of finding the right calibre of men.

Surprising to many of those present at the dinner was the implication in Air Marshal Constantine's statement that the introduction of Chipmunk flying in the initial selection of pilots was merely being *considered* at present. Nobody among his ABAC audience needed to be persuaded that a lack of flying aptitude could be demonstrated on a Chipmunk just as well as on a more sophisticated—and more expensive—type.

"Flight" photograph

AIR-TO-GROUND study of a Piper Caribbean used by "Flight" on a visit to the Blackburn Aircraft test airfield, Holme-on-Spalding Moor, Yorks. In the foreground may be discerned a Blackburn Buccaneer. Its low-level capability is being demonstrated by J. G. ("Bobby") Burns

FROM ALL QUARTERS

Handley Page Rumours

LAST week it was reported unofficially that McDonnell Aircraft Corporation of East St Louis, USA, had made an offer of about £6m for Handley Page Ltd. The report claimed that the board of the British Company were "holding out for 21s per share"; this represents a price of some £5,880,000, compared with previously announced company assets of £4,135,000. The value of Handley Page shares jumped from 10s 7½d to 15s, but slipped to 13s when both companies stated that the rumour was unfounded.

Both, however, admitted that they were engaged in negotiations, but these seem to have little connection with the acquisition of the British firm by McDonnell. The St Louis company is known to have been holding discussions with British aircraft companies other than Handley Page, and it seems likely that the talks are limited to reciprocal deals in each other's products and research programmes. It would not be surprising, for example, if Handley Page were to make a British version of McDonnell's Quail decoy missile for Bomber Command.

The 100km Closed Circuit

THE Russians claim that Konstantin Kokkinaki, flying an "S-66 single-jet aircraft," has put up an average speed of 2,148.3km/hr (1,335 m.p.h.) round a 100km closed-circuit. He flew at a height of 44,300ft.

The officially homologated record at present stands to the credit of Boris Adrianov, who on May 28 flew a "T.405" delta-winged aircraft round a 100km course at 2,092km/hr (1,299 m.p.h.). Powerplant of the aircraft was a "Type 13" turbojet of about 20,000lb thrust, presumably with reheat.

Both the foregoing performances are inferior to the claimed speed of 1,390 m.p.h. averaged over a course of the same distance by a McDonnell F4H.

Opening Night

"CHOSEN by virtue of my disastrous longevity" was Lord Brabazon's assessment of his role in declaring open the new lecture theatre of the Royal Aeronautical Society on December 2. The ceremony included an account of the history of the lecture theatre by the president of the Society, Dr E. S. Moult, illustrated by slides and a film, *Realization of a Dream;* and a well-phrased vote of thanks to Lord Brabazon expressed by Mr W. Gordon Wilson, chairman of the Graduates' and Students' Section.

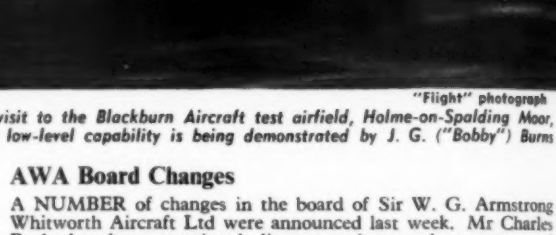
Dr A. M. Ballantyne, secretary of the Society, gave credit to three past presidents for the realization of the Society's plans for the new hall. Sir George Edwards had put together the bones of the idea; Sir Arnold Hall had given substance and form to this skeleton; and Mr Peter Masefield had clothed the body.

AWA Board Changes

A NUMBER of changes in the board of Sir W. G. Armstrong Whitworth Aircraft Ltd were announced last week. Mr Charles Bayly has been appointed director and general manager, and Mr C. S. Emery, who has been sales director since 1953, is to retire at the end of this year. The company secretary, Mr F. D. Stallabrass, has been made an executive director.

The position of director and general manager was held formerly by Mr W. S. D. Lockwood, who was made managing director last September upon the retirement of Mr H. M. Woodhams (who remains on the board) as chairman and managing director.

At present Mr Bayly is an executive director of AWA and chief engineer of the Armaments Division. He will be succeeded as chief engineer on January 1 by Mr John Dent, who is joining the company from Short Bros & Harland Ltd, where he is chief engineer (guided weapons).



Messrs Bayly, Emery and Stallabrass

Mr C. Bayly, MIMechE, FRAeS, joined AWA in 1939 on the aircraft production side, served in the RAF for five years and was subsequently engaged on guided-weapons work for the MoS. After that he was rocket-motor design manager to ICI, and rejoined AWA in 1955, working on Seaslug as chief project engineer; a year later he was made chief engineer (armaments).

Mr Claude S. Emery, now retiring after reaching the age of 65, has aviation experience dating from 1916, when he became an RFC pilot. He joined Armstrong Siddeley Motors in 1927, managing their affairs in Northern and Central Europe for ten years before returning to the parent factory in Coventry. He transferred to AWA in 1948 and became sales director in 1953.

Mr F. D. Stallabrass, ACA, was appointed secretary of the company in 1947, after previous service with Peat, Marwick, Mitchell & Co, the chartered accountants.

Mr John Dent, BSc, AMIMechE, with Admiralty experience from 1944 to 1955, during which period he worked closely with the RAE on early guided-weapons control equipment, joined Short Bros to form the Seacat development team.

From January 1, the AWA board will consist of: Sir Roy Dobson, chairman; Mr W. S. D. Lockwood, managing director; Sir Thomas Sopwith; Mr H. R. Watson, technical director; Mr J. A. R. Kay; Mr J. T. Lidbury; Mr S. D. Davies; Mr F. Martin; Mr H. M. Woodhams. Executive directors: Mr C. Bayly, general manager; Mr E. D. Keen, chief designer; Mr F. D. Stallabrass, secretary.

IN BRIEF

The chairman of the air sub-committee of the Conservative Party defence committee in the House of Commons (session 1960-61) is Sir Arthur Vere Harvey and the vice-chairman Mr R. Collard. The hon secretary is Mr John Eden.

BMW announce that, by switching to direct injection, they are increasing the rating of the flat-six piston engines made under licence from Lycoming from 250 to more than 300 b.h.p., and that they are currently engaged in the design of a miniature by-pass turbojet weighing 220lb and giving a thrust of 660lb.

Mr Jack Davison, managing director of Hawker de Havilland (Pty) Ltd, distributors for the Hawker Siddeley Group in south, central and east Africa, Portuguese East Africa, Angola and the Belgian Congo, is also to become managing director of Hawker Siddeley Brush (southern Africa) from April 1 in succession to Mr F. A. Vaughan, who is returning to London. This will bring under one control the aviation and industrial interests of the Hawker Siddeley Group in southern Africa.

Hunting Surveys Ltd have been awarded a contract by the Ministry of Transport for the aerial survey of part of the proposed motorway from Birmingham to south of Bristol.

The 1961 aircraft sales weekend organized by W. S. Shackleton (Aviation) Ltd will be held at Baginton Airport, Coventry, on Friday, Saturday and Sunday, April 28, 29 and 30. For the last three years this function has been held at Kidlington. The company state, "While we are all very sorry to leave Oxford, we feel it is most important to move nearer to the centre of England and to transfer to a larger airfield with more facilities."

Formerly deputy chief designer (weapons) of Vickers-Armstrongs (Aircraft) Ltd, Mr E. Smyth, BSc, AFRAeS, has been appointed sales manager (guided weapons). He will be responsible to Mr E. L. Beverley, sales manager (guided weapons) of British Aircraft Corporation, for the sales, customer relations and after-sales service of the weapon products of Vickers-Armstrongs (Aircraft) Ltd. The company's current weapon, ordered recently by the British Army for evaluation trials, is the man-portable Vigilant anti-tank missile.

(*Further "From All Quarters" news appears overleaf*)

GERM of an Idea

IT is now clear that ground-effect transport vehicles are here to stay, and will represent an increasing share of the business of firms which previously made aircraft. In the Hawker Siddeley Group activity in the field started a little over a year ago when Mr Maurice J. Brennan, formerly chief designer of Saunders-Roe and responsible for that company's rocket/jet intercepters and (with the inventor, Mr C. S. Cockerell) for the original Hovercraft, joined Folland Aircraft as chief engineer. By that time a member of the Group, Folland were perfectly placed to become the Hawker Siddeley hovercraft company, and work was at once started in exploring the fundamentals of these craft, culminating in the construction of a series of GERMs (ground-effect research machines). In the current issue of *Hawker Siddeley Review* the first details are given of the manner in which Folland are attacking the problem of achieving the optimum lift and propulsion.

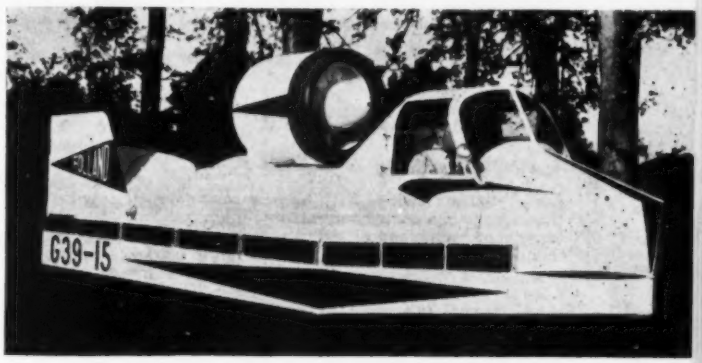
Lift Although simple plenum-chamber vehicles have been built in America, all Folland's work is being directed towards improvement of the curtain type of vehicle, which appears to be commercially far more useful owing to its greater hover height. Only the curtain vehicle can operate over rough ground or open water. The arrangement adopted in the earliest ground-effect vehicles of building the whole craft around the powerplant and duct system is operationally unattractive. It seemed logical to Folland to put the curtain system round the edge, leaving the interior unobstructed for the payload.

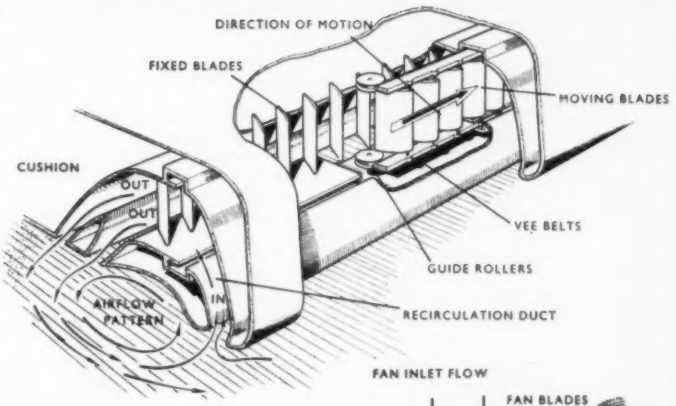
Using this approach the company has been testing a number of arrangements, all of which lend themselves to curtain recirculation in order to reduce power consumption. The largest sketch shows a novel linear-fan arrangement, in which the moving blades are carried on flexible belts operating in a duct continuous round the periphery of the vehicle. The arrangement can be applied equally well to rectangular or oval hulls, and has shown itself better able than a conventional fan to withstand impact damage.

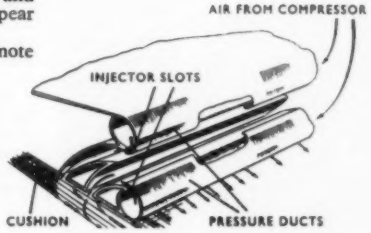
The smallest sketch shows a system which, although apparently simple and attractive, "poses a number of problems in design and manufacture on a large scale." The idea is that the compressor should discharge through narrow injector slots to entrain a much larger mass flow for the curtain. Possibly a better arrangement (third sketch) is for the engine to drive through flexible shafts to small fans distributed around the periphery of the vehicle. Operating at high r.p.m., these fans appear to pose few development problems, could readily be serviced or replaced and could be employed in any size of vehicle (a larger vehicle merely having more fans). All the above systems should achieve adequate hover height with a thrust of the order of 10 per cent of vehicle weight.

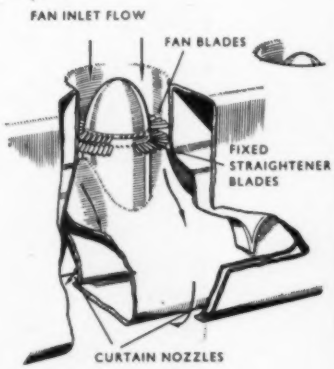
Propulsion For the most difficult types of operation propulsion and manœuvring forces demand power requirements quite as large as those needed for lift. For operations over smoother surfaces, considerable economies can be effected by employing surface contact, in the form of immersed sidewalls and a marine propeller or water jet, or, for land operations, low-pressure tyres or tracks. In the latter case the cushion would support most of the weight. Various types of powerplant have been considered, and for vehicle weights greater than about 20 tons gas turbines appear essential.

After practical experience with GERMs, possibly in remote parts of the world, a series of commercial vehicles will be produced. The first Hovertruck will carry five tons of freight at up to 30 m.p.h. over land or reasonably smooth water, and if necessary will operate all day without refuelling. Future Hovercoaches are envisaged for amphibious operation, carrying 20 tons or 150 passengers at 80kt, and having a range of 600 n.m.









Above is seen the first GERM, now being instrumented. It is at present powered by two Royal Enfield 700cc twins, but other engines are likely to be tried later. The propulsive duct is prominent. The drawings of curtain-producing systems reveal: upper, the linear-fan arrangement; left, a high-pressure injection system; right, a high-speed fan

POWER POLE measuring 36ft in length lifted, prior to erection, by a Westland Whirlwind. The Whirlwind has been used to examine its suitability for routine aerial inspection of overhead power lines of the South Western Electricity Board. It is estimated that a job that would take six men four days could be done in an hour

VISITING BROUGH recently to see the work of Blackburn Aircraft Ltd was Mr Peter Thorneycroft, Minister of Aviation, seen (second from left) with Mr T. Bancroft, production director (left); Sir Roy Dobson, chairman; and Mr N. E. Rowe, joint managing director. Other VIPs who have lately visited Blackburn include the Minister of Defence, the Civil Lord of the Admiralty, and the Secretary of the Admiralty

FROM ALL QUARTERS . . .

RAF Flying Training and the Clubs

ONLY ten per cent of RAF aircrew candidates passing through the Aircrew Selection Centre, Hornchurch, are up to the required entry standards of physical fitness, aptitude and intelligence. Of this ten per cent, approximately half fail to complete their training. These facts were disclosed by Air Marshal Sir Hugh Constantine, Air Officer Commanding-in-Chief of Flying Training Command, in a speech at the annual dinner of the Association of British Aero Clubs and Centres in London on November 30.

Congratulating the clubs on their contribution to the cadet flying scholarship scheme, the air marshal said that, since the start of the scheme in 1950, no fewer than 3,012 scholarships had been awarded. Of these scholarship-holders, 1,150 had joined the RAF as aircrew; 254 had joined the Service in other categories; and 56 had joined the Army or Navy. Many others had entered the airlines and the aircraft industry. Compared with aircrew entrants with no previous flying experience, those with some flying experience showed one-half the wastage rate in basic training, while the rate for the holders of scholarships was only one-sixth. Flying Training Command was thinking of introducing the Chipmunk into the initial selection process on the reasoning that, if one could not fly this type, one could not fly a more sophisticated type.

The Air Force needed to recruit 50 per cent more pilots and navigators than the present rate, Sir Hugh said. The Service's main problem was to get the right calibre of man, but existing standards were not to be lowered.

Pilots would always be needed by the RAF, the air marshal emphasized, and the job of the clubs would continue to be a most important one in future years. Some 23 per cent of the airspace over this country was controlled airspace, but "More control is necessary in the time ahead if we are all to fit into this small country of ours . . . How *can* we fly around in the years ahead without a radio?"

Sir Lionel F. Heald, a vice-president of the Association, said that the ABAC had expanded from 59 clubs in 1950 to 126 now; with 37,000 flying hours annually, increasing to 95,000 over the same period. There was a danger of forthcoming pressure to remove the petrol tax relief which the clubs at present received. If this tax relief were taken away, Sir Lionel said, it would mean an extra cost to the clubs of some £60,000 per year. The cost of flying would go up, and the utilization of aircraft would go down. This in turn would itself cause costs to increase further, and so the number of people able to learn to fly would be reduced.

The ABAC Lennox-Boyd Trophy for the most efficient club went this year to Northamptonshire Aero Club. Other places at the top of the list were: (2) Oxford Aeroplane Club; (3) Exeter Aero Club; (4) London School of Flying, Elstree; (5) Cumberland Flying Club; and (6) Southend Air Centre.

THE RIETZKE AWARD to "the airman showing the greatest promise in the field of electronics" is here examined by the recipient, Sgt J. H. O. Willacy. It was presented to him at RAF Cottesmore by Mr Eugene H. Rietzke, centre left. Looking on are (extreme left) Air Cdre J. R. Morgan, and (extreme right) the Station Commander, Gp Capt A. D. Mitchell. Mr Rietzke is president of Capitol Radio and Engineering Institute, of Washington DC, the European Division of which has recently run a course for airmen

RB.162 and 163

IN London last week, during the discussion referred to on page 934, Mr J. D. Pearson, chief executive and deputy chairman of Rolls-Royce Ltd, announced that the RB.163 transport engine, powerplant of the Trident and scheduled for the VC.11, had been named the Spey. This perpetuates the policy of choosing the names of British rivers, and Mr Pearson said that he was sure that "the large Scottish element within the company will applaud our choice."

The RB.162 is a natural outgrowth of the RB.108 and is the logical next step beyond that engine in the company's range of lift/thrust units. With a rating "of the order of 4,000lb," it has a thrust/weight ratio of some 16 : 1. Discussions are in hand with a view to an MoA development contract; it is not specified for an aircraft named as an official requirement, but many British and foreign aircraft constructors have chosen it as the basis for design.

Missiles and Spaceflight

SOVIET SATELLITE IN LOW ORBIT

The launching of a sixth Earth satellite by the Soviet Union—third of the 4½-ton craft called "space-ships" in official Russian announcements—took place on December 1. Although the official reports implied, as usual, that all went according to plan, the exceptionally low orbit achieved led reputable scientific observers in this country to suggest that this perhaps indicated a launching error. The initial announcement on December 1 stated:—

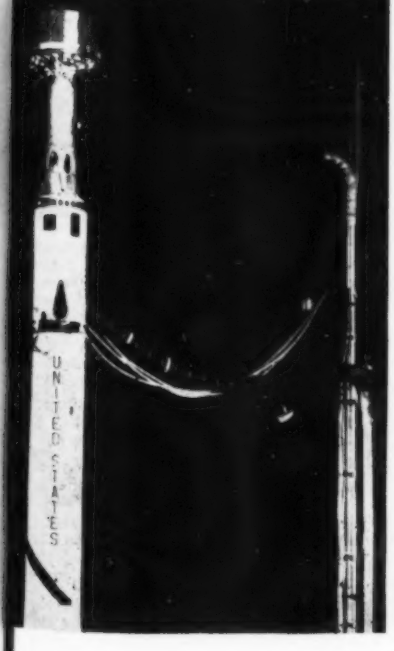
"In accordance with the programme of scientific research the third space-ship was orbited as an Earth satellite in the Soviet Union on December 1, 1960. For medical-biological research in the conditions of spaceflight, experimental animals—dogs named *Pchelka* and *Mushka* (Little Bee and Little Fly)—have been placed in the cabin of the space-ship. In the cabin there are other animals, insects and plants.

"The experimental animals are being watched by means of radio-television and telemetering systems, which play back physiological data about the state of the animals. The scientific measuring instrumentation installed in the space-ship provides for several scientific investigations of outer-space physics.

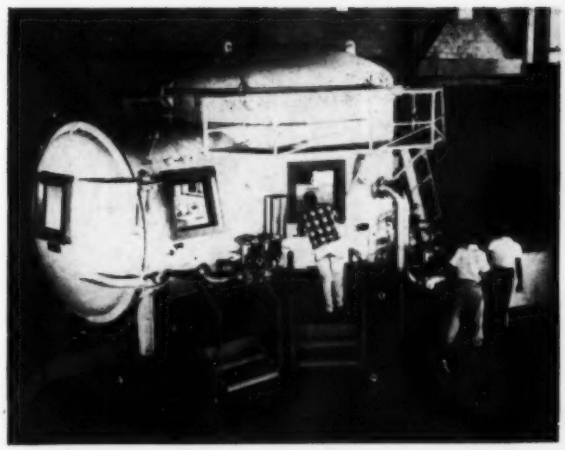
"The weight of the third Soviet space-ship, without the last stage of the carrier rocket, amounts to 4,563kg (10,060lb). It moves along an elliptical orbit. According to preliminary data, the initial rotation period of the space-ship along its orbit equals 88.6min, with the orbital perigee and apogee equalling approximately 187.3 and 265km (116 and 165 miles) respectively. The orbit's inclination to the equatorial plane is 65°.

"The space-ship is provided with a 'signal' transmitter, which operates on the frequency of 19.995Mc/s in the regime of telegraph signals of variable duration. The instrumentation is fed from chemical and solar sources of electricity. According to the available preliminary data, all the instrumentation on board the ship functions normally. The ground radio-technical stations are tracking the third Soviet space-ship regularly."

Later official comment added: "This ship will be followed by new ones, which will bring even nearer the hour when a man, a Soviet man, will leave for space." Academician Anatole Blagonravov was reported as saying: "The world knows that one of the most important achievements of the earlier launching of a satellite cosmic space-ship was the precise realization of all preliminary calculations and precise landing. The experience accumulated during the experiment with the second space-ship has been used to improve the latest one."



Close-up view of Tiros 2, the 280lb weather satellite launched from Cape Canaveral on November 23, mounted on top of its Thor-Delta booster prior to launch. Note connections between launch vehicle and umbilical tower. Details of early results obtained from Tiros 2 are given on the next page



A new Project Mercury facility at Cape Canaveral is this high-altitude chamber in which a complete Mercury capsule mock-up can be placed. In it, the seven astronauts will experience high-altitude conditions, and will gain experience of the spacecraft's environmental-control system. The chamber was installed by Tenney Engineering Inc

Blagonravov went on to say that it had been possible to place an even larger amount of scientific equipment on board the third space-ship than on the second. It had also proved possible to expand the research programme. He commented that, as science and technology progressed, the dimensions and weight of scientific instruments decreased, while the technology of measurement improved. All this would enable Soviet scientists to conduct increasingly refined experiments.

Later the same day it was reported that all instruments on board the space-ship were functioning well, and had indicated that the temperature inside it was being maintained at the predetermined level. More accurate orbital data were also given—period of revolution, 88.47min; perigee, 180km (112 miles); apogee, 249km (155 miles); inclination, 64.58°.

On December 2 it was announced that, by 9 a.m. GMT on that day, the planned programme of the third space-ship had been completed. The signal was given for its descent from orbit but "since the space-ship descended along a non-calculated trajectory, it burned out on entering the dense layers of the atmosphere."

Speaking in Moscow prior to this latest launching, Prof Sergeyev had said that the Soviet Union possessed the means and conditions for manned spaceflight. He called for further practical demonstrations of recovery from orbit, and announced that the capsule in which the dogs Belka and Strelka flew was in excellent condition and could be used again.

NUCLEAR ROCKETS FOR SPACE USE

"Nuclear energy in some form, used directly in a rocket or indirectly in a nuclear-electrical system, is required if man is to travel freely in outer space," according to Mr Harold B. Finger, manager of the joint Atomic Energy Commission/NASA Nuclear Propulsion Office. Speaking in Cincinnati on November 17, Mr Finger said that, for a manned mission to and from the Moon, the best combination was one employing both chemical and nuclear power. He estimated that an all-chemical rocket vehicle would require six or seven stages to carry out such a mission, and would use up a total thrust of 10-15 million lb. A four-stage combination of chemical and nuclear-powered rockets to carry out this mission would need only three million lb of thrust.

The speaker stressed the importance of employing fewer stages on a lunar mission, since experience showed that equipment failures were most often associated with stage separation. Since the chemical-nuclear vehicle would have fewer stages, it would offer greater reliability. In addition, a nuclear system would mean fewer fuel problems, since it would use one propellant instead of the two in a liquid chemical rocket.

In a four-stage chemical-nuclear lunar launch vehicle, the top three stages could employ nuclear power. The powerplant would consist of a nuclear reactor to heat liquid hydrogen to 4,000-5,000°F, forcing the hydrogen through a nozzle to create thrust. To heat the hydrogen to such a temperature required a very high thermal power from the reactors. For the first nuclear-powered stage, an estimated 15,000MW would be needed, 8,000MW in the second stage, and 1,500MW in the third or final stage. The goal would be to produce about 50lb of thrust per megawatt.

Mr Finger stated that the large performance potentials that were possible with the nuclear rocket made the development programme very worthwhile. He said the KIWI-A reactor tests run at Los Alamos in July 1959 were extremely successful. He

Above is one of the first photographs of "Sherwood Forest," the missile compartment of a US Navy FBM submarine. The photograph shows some of the 16 tubes of USS "George Washington." Later FBM submarines have the Polaris A-2 missile, 3ft longer than the 28ft A-1 and having a range of 1,730 miles. The first A-2 (left) was successfully launched on November 10; further details of the A-2 were contained in our November 18 issue (page 770)

Missiles and Spaceflight . . .

described the KIWI-A as having a graphite reactor with ¼in flat plate fuel elements. Gaseous hydrogen was passed between the plates and out of a jet nozzle that fired upwards so that there was no need for a flame deflector with related heat flux and reactive materials problems. The KIWI-A reactor was cooled by water.

The KIWI-A prime reactor was tested early in 1960, Mr Finger said, and the KIWI-A-3 was tested late this year. Both were similar to the KIWI-A, except for different cores. All three KIWI reactors had employed gaseous hydrogen as the working medium, but tests will be run next year on a reactor employing liquid hydrogen, which would also be used to cool the nozzle and the pressure shell of the reactor.

Facilities for the liquid hydrogen tests are being modified at present at the Nevada proving site some 80 miles from Las Vegas, and a second test facility is being constructed so that two reactors may be tested simultaneously. Mr Finger said that AEC and NASA were now working toward lightweight nuclear rocket engines and flight test vehicles. He indicated indirectly that the development of both is well under way by saying that a complex test facility is under development to test such reactors and vehicles. Aerojet has been selected to build a down-firing facility to test the lightweight nuclear rockets at the Nevada test site. NASA and AEC together will select a contractor to develop the first engine soon.

In general, the research and development programme for a lightweight nuclear rocket and flight vehicle is being worked out as a four-part effort. The first step is to establish on the ground that nuclear reactors for flight are feasible and are capable of handling temperatures of 4,000-5,000°F. The second step will be to fly the reactors. As yet no decision has been made whether to flight-test the new lightweight nuclear rockets by launching from the ground, or whether to first shoot them into the upper atmosphere with a first-stage chemical booster before firing the nuclear rocket, and then let it drop into the ocean, or thirdly, whether to launch nuclear test rockets into space and let them go.

The third step of the programme calls for the development of improved reactors with the temperatures and power densities required for useful missions. This might lead to the clustering of nuclear rocket engines. Finally, the fourth phase calls for continuing research on advanced materials and technology so as to provide back-up knowledge that will afford product improvement as time goes on.

Mr Finger expressed the view that nuclear rockets for first-stage propulsion were a long way off. "The early version of the Saturn booster will be able to put 30,000lb into an Earth orbit," he said. "To do that with a single nuclear rocket stage would require a take-off gross weight of about 300,000lb and a reactor system capable of generating 12,000MW, and we are a long way from developing such a system."

DOUGLAS ENTERS PROPULSION FIELD

"Research and development of specialized ultra-high-energy propulsion systems in the nuclear, chemical and electrical fields" are included in the programmes of Astropower Inc, a newly formed subsidiary of the Douglas Aircraft Co. Electrical rocket propulsion-system work will include ion engines, heavy charged particle engines and thermal arc plasma engines. President of the new company, which is an outgrowth of Aero-Space Technology Inc, is Mr Y. C. Lee.

At the end of November Mr F. M. Osborne, Australian Minister for Air, announced that deliveries of Bristol Bloodhound Mk 1 weapon systems were taking place to the first Australian GW unit, to be established next month at RAAF Williamtown, NSW.

Last month the Soviet newspaper *Izvestia* published an article by Marshal of Artillery I. Kazakov, in which it was stated that Soviet surface-to-air missiles can hit all types of aircraft as well as "offensive pilotless devices at great altitudes."

As announced by the Admiralty on November 17, the first Royal Navy team for measuring nuclear radiation has completed its training and will be posted to Holy Loch to check that nothing leaks from the propulsion system of the US Navy's FBM submarines. The team consists of five men, and costs £184 per week.

According to the London *Daily Mail* "A tree-top flying H-missile" is to be a primary weapon of the British Aircraft Corp's TSR.2 attack aircraft. The newspaper states that the new missile is "One of a new generation of secret British rockets designed to operate at not more than 50ft above the ground."

According to a dispatch from New Delhi, dated November 24, Tom Navision (USAF) and Peter Mulgrew (RNZN), members of Sir Edmund Hillary's Himalayan expedition, saw the launch of a vehicle on the Tibetan side of the Nepalese border the previous month which "could only have been a rocket."

Six US Congressmen flew to RAF Driffield, E. Yorks, on November 28 to investigate charges that the "two-key" system for joint US/UK control of Thor missile was open to abuse. The following day they flew to Paris, and on December 1 inspected nuclear warheads for US weapons (said to be Honest Johns) stored in the Netherlands.

Digital computers are the main clearing-house for information in PEP, the programme evaluation procedure now standardized by the US Air Force for major systems. Applied for the first time to the development of the Skybolt ALBM, PEP is an automatic and continuous review of every detail of the development of all parts of the weapon system in order to predict possible future bottlenecks.

Last month three former engineers from Boeing announced that they had formed a company known as The Rocket Research Corp to handle research, development and manufacturing. At Boeing the appointments held by the three engineers were: chief of the propulsion research unit; head of the advanced propulsion group; and head of the chemical-rocket evaluation programme.

The US Navy's Transit 3A "double" satellite developed a fault and was destroyed by ground command after launch from Cape Canaveral on November 30. This was an attempt to repeat the successful "piggy-back" launch of June 22 last when the Transit 2A navigation satellite and the NRL radiation satellite Greb were both placed in orbit. Launch vehicle on both occasions was a Thor-AbleStar.

"Radio Techniques and Space Research" is the theme of next year's British Institution of Radio Engineers convention, to be held at Oxford during July 5-9. Technical sessions will be devoted to the role of radio techniques in space research; satellite engineering problems; extra-terrestrial measurements; telemetry; techniques in radio astronomy; and satellites in terrestrial communications.

A Royal Medal of the Royal Society was awarded on November 30 to Prof A. C. B. Lovell, director of the Nuffield Radio Astronomy Laboratories at Jodrell Bank. In his citation the President of the Royal Society, Sir Cyril Hinshelwood, said "The conception and design of the large steerable paraboloid telescope are due to Lovell. Its construction represents the most significant advance in radio astronomy. . . . It has proved invaluable for the tracking of stellar objects, but promises to reveal much more about galactic radiation."

A one-day symposium on the use of communications satellites will be held by the British Interplanetary Society on May 12, 1961. Papers will include *Communications Satellite Systems Suitable for Commonwealth Telecommunications*, by Dr W. F. Hilton; *The Synchronous Communications Satellite*, by R. P. Havilland; *Low-cost Communications Satellites*, by A. M. Peduzzi; *Engineering and Economics of Satellite Communication Systems*, by G. K. C. Pardoe; and *Active Communications Satellites*, by Dr G. E. Mueller.

A total of 998 pictures had been transmitted by the Tiros 2 weather satellite up to 5 p.m. GMT on November 28, five days after launch. Of these, 312 were taken by the narrow-angle television camera, of which 85 were of practical use; and 686 were from the wide-angle camera, of which "between five and ten per cent" contained some useful information. The quality of the pictures taken by the narrow-angle camera was good, according to NASA, but those from the wide-angle unit were not.

The use of plastic foam to fill inflatable tubes in the construction of future satellites and space stations is now being investigated by the Astro-Electronics Division of Radio Corporation of America, Princeton, New Jersey. Intended to overcome the size and weight limitations encountered in launching folded structures designed to be set up in space, this technique is believed to make possible, for example, an inflatable-tube structure weighing 32lb which could provide a 44ft diameter disc able to carry a solar-cell array weighing 420lb.

In the Minister's Opinion . . .

Mr PETER THORNEYCROFT

interviewed by FRANK BESWICK

IT is nearly a year ago since Frank Beswick wrote for "Flight" the last of a series of interviews—"What Course for the Industry?"—with leading figures in British aircraft manufacture. He put to them a number of questions about the changes they expected under the then-new Government. Now, in a further series, he is seeking what might be termed progress reports on the same subject; and he begins it with this interview with the Minister of Aviation. Mr Beswick, a former Labour MP, was Parliamentary Private Secretary to the Under-Secretary for Air in 1946-49 and Parliamentary Secretary to the Ministry of Civil Aviation in 1950-51.

FOUR months ago Mr Peter Thorneycroft moved into the Ministry of Aviation. His predecessor, within eight months, had inaugurated a new government Department, had brought about the most radical reshaping of any unnationalized British industry, and had legislated for an Air Transport Licensing Authority which others had been talking about for years. He then left.

Mr Thorneycroft came with experience as a Chancellor of the Exchequer, an imaginative mind, a strong will, a devotion to principle and a reputation for economy. My first question to him related to this latter characteristic.

Would you like to state your general attitude towards Treasury assistance to a privately owned aircraft industry?

"If I have a reputation of this kind at all, I hope it is because I am against extravagance rather than public expenditure as such. The fact is that I am now in charge of one of the biggest spending Departments and I doubt whether I shall go out with a reputation of not spending money."

But what about this particular point of spending public money through privately owned firms?

"If there was one field where this was justified I should have thought it was in aviation. There, public and private interests are irretrievably intermingled. We have, of course, an enterprising public organization in the Royal Aircraft Establishment as well as private enterprise, and we have both private and public customers for the end product. I do not see any better form of partnership than we have now."

But what about the actual check on this expenditure? The recent Select Committee Report seems to suggest that control is not as tight as it should be.

"Of course, Select Committees make very useful *post facto* examinations, and we all know that it is much easier then to identify mistakes. But I do not think we can blame anyone very much. Remember that people were being asked to make weapons which were entirely novel, and it was quite impossible to say how much the effort was going to cost. But over the years we have learnt from experience, and techniques are being found which should mean a closer control and check on future spending."

Your predecessor achieved a remarkable success in securing a radical re-shaping of the aircraft industry in such a short space of time and without statutory compulsion; would you say the pattern is satisfactory and fairly well fixed? Or do you expect any further significant changes?

"The industry is much more powerful than it was. The resources—capital and technical—which each group disposes are much greater. As to whether we have achieved the ideal in this new arrangement no one can yet say; we probably shall not *know* for five or ten years. I believe there will be further rationalization in the industry, but within each group rather than between groups."

The industry has an outstanding record in the export field, but overseas orders—apart from aero-engines—now appear to be drying up; is there more the Government can do to help, or do you think the industry itself could do more?

"The industry has done well, magnificently well, and on engines particularly. Prospects are certainly better now than they would have been without reorganization. Overseas sales need a servicing organization, which the industry is much better able to provide now than before. We are giving assistance—in money—for proving, tooling up, and even buying aircraft for stock. If the industry asked us to do more we would have to look at their suggestions. The Export Credit Guarantee Department is doing good work, and I doubt whether more could be expected from them."

But whilst we accept all that, doesn't it remain true that the order-books for the future are very thin? Isn't it a fact that the military orders from abroad are drying up? With the exception of the Vanguard order for Canada, the Comets for MEA, UAA and EAAC, the Avro 748 for India and probably the Herald for South America, there is no civil requirement.

"I think you are being too despondent. We are in an in-between period with civil orders, but there is no reason to believe that the VC10, for example, will not prove successful in overseas markets. NATO orders have been dropping off, but we must accept that there are other partners in the Alliance with goods to sell. I think we shall get our fair share. We are hoping there will be a requirement for the Hawker P.1127, and we have other expectations. As I have already said, I don't think we have to be despondent, and we must expect that so long as the Western Allies buy one another's goods, aircraft orders on occasions will go to other countries."

Could I ask if your Department has any longer-term policy with regard to international co-operation in space research and in the development of supersonic transports? You have spoken in favour of an international effort in these fields, but are we to assume that there will be scope for two separate Western projects in both space and supersonics?

"Let's take the supersonic transport first. I would like to see one supersonic transport for the West. Of course there are different ideas as to whether we should have a Mach 2 or Mach 3 machine, and discussions are taking place. But the problems, including the operational problems—noise for example, and airports—can only be solved on an international basis, and I would hope that we shall be able to get an international agreement."

Do you mean an agreement between ourselves, Europe and America? Can I say you are "optimistic" about getting such complete Western agreement?

"Optimism is probably a little too high, but I would say we have a fairly good chance. Some people may wish to 'go it alone,' but it would seem to me to be very much better if we could go it together."

What about space?

"The position there is slightly different. The Americans are very much further advanced. There is definitely going to be a European effort in space research. We have, of course, the European agency set up for this purpose, but the real question is whether we should drop out of the heavy-launcher project. There is, of course, an argument for saying that this would be too expensive, but I think the possibilities are as interesting as they are expensive. In terms of such things as a future communications system a heavy-launcher programme could be eminently worthwhile for Europe. Looking at it from that point of view I think we should go forward."

There is criticism, on the Continent especially, that in this matter of international co-operation we have, in the past, been short-sighted and selfish; the instances of the jet trainer and the Caravelle can be quoted. Do you feel this criticism stands in the way of future co-operation?

[Continued overleaf

In the Minister's Opinion . . .

"It is a perfectly fair point that if we want Europe to buy from us then we must be prepared to buy from them. It must be a two-way affair. But although it might be possible for the other chap to say we ought to have bought more from him, I fancy that we could produce an equally long list of things which we feel he should have bought from us. I am sure that all this will not stand in the way of future co-operation. The matters before us now will not be judged on the past but on the benefits to be obtained in the future."

Turning to the operating side of your responsibilities, has a date been fixed for the new Licensing Authority formally to take over, and do you expect that any considerable operational changes will follow?

"The regulations will have to be debated, or at least they will be open to debate on a Prayer, and we expect the new board to begin hearings early in the New Year. The new licensing system seems a sensible arrangement which has commended itself widely. I do not expect any sensational changes to take place—I cannot visualize the independents being put out of business or the corporations being undermined."

Probably the most important recent developments have been the agreements reached between independents and the corporations to cover specific routes. To what extent do you foresee similar agreements in the future? And do you not feel that the type of agreement already made between BOAC and BUA, for example, the details of which are not known, is contrary to the spirit of the new licensing arrangements—the hearings of which were to be in public? Will the full facts about these agreements in future be made known publicly?

"There seem to be two ways of approaching this matter. It is possible for the independents and the corporations to get together and work out a mutually satisfactory arrangement which they could then present to the board. It would then be up to the board to issue the licences if they were required for new services. On the other hand, the independents and the corporations could fight it out publicly before the board. In most cases I would have thought the first alternative preferable."

With regard to licensing I have found that there is some confusion among colonial aviation authorities as to the dividing line between their responsibility and that of the new board in the issue of licences.

"If there has been any confusion, the circular which the Colonial Office are sending out should clear it up."

* * *

There is no doubt that the first Minister of Aviation did an extraordinary amount of preparatory work. Some believe, however, that the second Minister has the more difficult task of ensuring that this work yields fruitful results. From the ready way in which Mr Thorneycroft answered my questions it seems fair to say that he is tackling this task with enthusiasm and understanding. But then the biggest issues facing the industry for which he now bears responsibility—namely, Britain's future position in space research and supersonic transport—are not solely within his power of decision. It is not only the Treasury but the Government departments overseas whose ideas will count. The impression I received is that the British Minister of Aviation will subject their ideas to the right kind of influence.

Sport and Business

OXFORD AEROPLANE CLUB is to use an Apache and two Tri-Pacers to start a new air service for businessmen at Birmingham Airport. The service, scheduled to begin in the new year, will include hire of aircraft to businessmen-pilots; hire of aircraft as air taxis complete with pilot; and flying instruction, when required, during business flights.

FIRST WINNER of the Norfolk and Norwich Aero Club's Bignold Trophy, awarded on the results of a flying and navigation competition, is the club's chairman, Norman Brett. The trophy was presented last month at the club's annual dinner and dance.

THE FULL RANGE of Cessna aircraft now offered by Airwork Services Ltd were the subject of two recent demonstrations. The first was at Honeydon Airstrip, near Bedford (by kind permission of the owner, Mr C. Spencer-Thomas), on November 12; and the second at Panshanger Aerodrome, headquarters of the London Aeroplane Club, on November 17. It is to Panshanger that Airwork Services are moving from Booker.

Conditions at the second demonstration (unlike those for the first, a calm and clear afternoon) were not favourable, with a cloud base of 700ft, lowering in showers. This limited the flying, but did not prevent the showing of a film depicting the 1961 Cessna range, of which three examples (185 Skywagon, 172 Skyhawk and 310F) were recently illustrated in *Flight*. Under the title *What's your need?*, the film outlined the economics of the various Cessna types.

A FRENCH LIGHT AIRCRAFT designed by René Leduc and piloted by Raymond Davy has recently set up—subject to FAI confirmation—two new 100km closed-circuit speed records. The aircraft is the Leduc RL.21 powered by a SNECMA 4L-00 engine developing 135 h.p., and both records were set up from Nantes (Chateau Bougon) Airfield. The first record was in class C.1a (aircraft under 500kg) and the second in class C.1b (aircraft between 500 and 1,000kg). The speeds claimed are respectively 313.5km/hr and 316.2km/hr (194.2 m.p.h. and 195.8 m.p.h.).

This is yet another demonstration that surprisingly high speeds can be achieved with aircraft having very low-powered engines. The previous records were held respectively by Richard V. Ohm in an Ohm-Stoppelbein Special Mid-wing and Ron Payne in a Miles Hawk Speed Six (the latter aircraft had a 205 h.p. engine). In June 1949 another Leduc light aircraft, the RL.16, gained the world height record for aircraft with engines of under two litres capacity, with a climb to no less than 7,800m (25,600ft).

There are at present several home-built two-seaters in the United States which are achieving cruising speeds of well over 150 m.p.h. with engines of less than 100 h.p.—and they are not necessarily under-winged, over-hot monsters or special racing designs. Some of them have fixed nosewheel undercarriages. The attainment in this country of really high cruising speeds on very low power seems by comparison to have been almost totally neglected.

RETROSPECT

From "Flight" of December 10, 1910

Pilots' Certificates and Observers: Last week in the notes on the London Aerodrome doings it was suggested that Mr Bouwens was unable to obtain his official certificate owing to the "belated arrival" of the official observer. We understand that no fault whatever lies with the observer, who was in attendance by about 2 o'clock on the Saturday, notice of the attempt only having reached the Royal Aero Club on the same morning, and that it was in consequence of the thick fog that Mr Bouwens decided to abandon his tests. In fact, Capt Board subsequent to this decision successfully went through his flights and qualified for his certificate.

MOSCOW FLYING CLUB, it is reported, now possesses several flapping-wing aircraft. One, known as the "butterfly bicycle" consists of "wings like a bird's with an engine that is strapped to the back"; another, known as the "insect craft," has wings like a mosquito's which beat five times a second. No performance details have been given.

THE PIPER CHEROKEE all-metal, low-wing four-seater is to enter production at the company's new plant at Vero Beach municipal airport, Florida, early next year. The two-seat Colt is already in production at Lock Haven, Pennsylvania.

Left, the 1961 Beechcraft Model 50 Twin-Bonanza, available with either two 295 h.p. Lycomings or two 340 h.p. Lycomings. Extra windows and redesigned instrument panel and cockpit layout are new features of both versions. Right, designed and built by William Warwick of Torrance, California, the Li'l Champ is a single-seat sports aircraft powered by a 65 h.p. Continental

Eurocontrol Takes Shape

It now seems likely that the Eurocontrol convention will be signed on Tuesday of next week. Following the signature by the six countries taking part, the convention will have to be ratified by individual parliaments and funds then allocated to finance the organization. A directorate of planning will probably come into existence immediately after the signature of the convention in order to prepare an experimental centre which is to be set up in the Paris area. When the convention is ratified, the planning group, initially located in Paris, will move to Brussels and form the nucleus of the headquarters of the control agency. The experimental centre will be to Eurocontrol what the National Aviation Facilities Experimental Centre at Atlantic City is to the Federal Aviation Agency. A commission for the safety of air navigation will also be formed.

Eurocontrol was first proposed during the fourth ICAO Eumed Region air navigation meeting at Geneva in January 1958 by West Germany, Belgium, Luxemburg, Holland and France. During the summer of that year, the directors of civil aviation of these countries met in Bonn and Luxemburg and decided to set up a legal and administrative group and a technical group. The first was to prepare the international convention and the second was

FLIGHT SYSTEM SURVEY

to consider civil/military co-ordination, estimate costs and make certain technical studies.

It was during the second half of 1959 that Britain intimated that it would like to join Eurocontrol and a representative attended the meeting in Brussels in October. Further meetings were held in January and May and preliminary arrangements were completed by the meeting of ministers in Rome in June. It is now reported that Italy is unwilling to join Eurocontrol, partly because the proposed upper airspace regions end at her northern frontier and partly because there is already joint civil/military traffic control in Italy. ATC over Italy is provided by the Italian air force.

The purpose of Eurocontrol is to provide control of both military and civil traffic in the upper air space (above 25,000ft over Britain and above 20,000ft elsewhere). The airspace will be divided into upper information regions and upper air routes designated not according to national frontiers, but according to most frequented routes and traffic zones. Before the Italian decision not to take part, five upper information regions were to be established, with a single control centre for each, located respectively at Paris, Luxemburg, London, Prestwick and Rome.

Within these upper regions, all aircraft amenable to normal control methods will be controlled. Military flights not amenable to normal control, such as interception and aerobatic training flights will be segregated in temporary areas or directly controlled by radar. In such cases the surveillance would be provided by military centres which would cover portions of UIRs, the military centres being in close contact with relevant civil centres. It seems certain that conventional control methods will have to be supplemented by computers and semi-automatic systems and a considerable market for equipment of this kind is therefore opening up. Several companies, including Signaal in Holland, have already made proposals to the technical committee.

Eurocontrol will obviously take some time to emerge in its full stature and existing installations will be used as much as possible in the meantime. It is also probable that joint civil/military air traffic control will follow in the lower levels—the intention of instituting such a system in Britain was recently stated in the House of Commons. Last July, three upper information regions were set up above 25,000ft, the boundaries being coincident with those of the existing London, Preston and Scottish flight information regions. It is the intention to reduce these to two UIRs at some future date. According to a recent Notam, all civil aircraft flying in the UIRs are now expected to file IFR flight plans and to follow one of three upper air routes. UAR 1 runs from longitude 10°W, over Belfast to Liverpool. UAR 2 runs from 10°W to Burtonwood over Prestwick and UAR 3 from the Shannon FIR boundary over Burtonwood to Hull. A radar advisory service has been operated for some time by the RAF radar station at Bishop's Court in Northern Ireland. By the end of January, 90 per cent of British upper airspace should have radar service.

This series of UIRs and UARs is in accordance with the Eurocontrol concept and also follows the ICAO regional plan. The other UIRs in Eurocontrol will probably follow a similar pattern. It will be for the experimental centre to develop the definitive equipment on an international basis. One of the major problems which will have to be resolved is that of an agreed and effective navigation aid, and Decca Navigator is likely to be considered seriously.

Above are the desk control console and viewer of the Pye Telecommunications radio-directed television system. The camera is controlled by UHF radio link and the picture returned by micro-wave link. Controls include pan-and-tilt joy-stick and switches for focus, range, lens selection and demisting or wiping of the viewing window. At right, load controller using Pye VHF radio to communicate with vans on the airport apron

Wind Tunnel Models by Computer

By employing new computer and machining techniques, Boeing now hope to be able to design and produce wind-tunnel models in a matter of days and to plot many factors in airframe design by computer. The idea originated in the mathematics department of the transport division at Seattle when a digital computer was used to plot all the surface points on a wing from basic master dimensions supplied by the aerodynamicists. From these plots, lofting drawings, cut by diamonds on metal sheets, were produced.

The method was extended so that complete aerofoils can now be plotted from basic information on chord, depth and camber lines. A numerical programme can be prepared for an automatic five-axis cutter which then produces the wind-tunnel model. In this way the model can be made in about three days and two new models could be prepared for testing each week. The cost is small and, more important, the lead time between project and practical test is drastically reduced. Actual skin panels of constant thickness are being cut under numerical control according to co-ordinates derived by computer.

It is quite possible that complete wings could be plotted from basic data stating only the general requirements, such as L/D and C_L. The next stage will be to use the computer technique to derive some of the stress and structure parameters and to define e.g., fuel tank volume and similar factors.

Similar, but less advanced methods have been employed by North American Aviation.

UHF for Denmark

The Danish Government has placed an order worth about £50,000 for high altitude UHF emergency transmitter/receivers made by WS Electronics Ltd. The radio weighs 8½lb and has a transistorized power supply. It is intended to operate even when all other electrical equipment in an aircraft has failed.

Tape Recorders for Sled Tests

Under pressure of increasing overcrowding of telemetry frequency bands in the US and the great cost of changing to the proposed 2,000Mc/s telemetry band, sled-test data are increasingly being gathered by tape recorders mounted in the vehicles. Other advantages are quoted as greater certainty of data recovery, lower cost and protection against "radio eavesdroppers." The USAF has ordered three recorders from the Leach Corp following six runs with a unit based on the Leach MTR-1200 airborne recorder. Further units have been ordered for the Holloman track and for the US Navy SNORT track at China Lake.

Straight and Level

"HELLO, Scruggs Aircraft? Could I speak to Mr Washbrain, please? This is Angus Swoon here, air correspondent of the *Daily Scoop*. At a meeting? But he's *always* at a meeting. Why doesn't your firm buy a Thinx Meeting Simulator, for heaven's sake? Oh all right, I'll hold on.

"Washers? Oh, hello, how are things? Wife all right? Splendid. No, no scandal, Washers—just a couple of small points. Is the Speedmaster still in production? Yes, I know it's been in production for years, but is it *still* in production? Why do I want to know? Oh, come off it, Washers. It's a secret? Why is it secret? All right, I'll hold on.

"Hello, yes? No comment, eh. No, of course I won't quote you. Well then, can you tell me its cruising speed? Yes, all right, I'll hold on.

"Hello, yes? Eh? Yes, I know it's terrifically fast, but what's the actual figure? Nothing to add to the article published in *Scruggs Heritage*? But that didn't give cruising speed. I see, it's not for publicatior. It's a secret, eh? All right, you win. Cheerio."

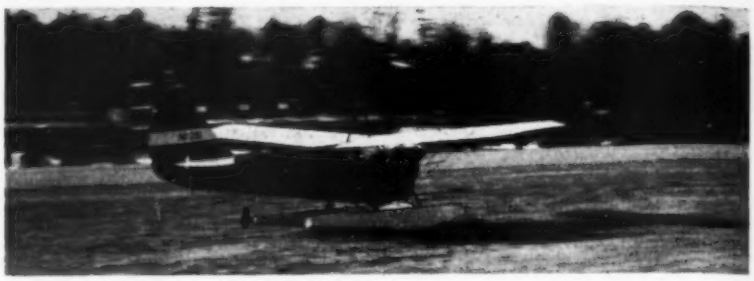
● During a brief two-minute interchange in the House of Commons on November 21 about air traffic control, reference was made to the following bodies:—

Air Traffic Control Advisory Committee
Civil Aircraft Control Advisory Committee
Air Traffic Control Board

You may recall that there is, in addition, an Air Safety Board, one of whose jobs is to keep an eye on air traffic control. And both the RAF and the USAF in this country have their own air traffic control authorities which co-operate with each other and with the Minister of Aviation. There is also the recently formed National Air Traffic Control Planning Group (*Flight*, November 11, page 759). These are all official bodies which advise, directly or indirectly, the Minister. I hope I have not left any other bodies out.

The Minister was being asked in the House about the need for unified air traffic control in Europe, with particular reference to Eurocontrol.

It seems to me that some unification of the official bodies advising the Minister on this question might not be out of order.



Routine stuff at Boeing's airfield at Renton: Pete Bowers lands his Aeronca C.3—which he has just taken off from the nearby lake—on the grass. He then tows it with his car into the hangar. For repairs to the floats? No, seriously, this sort of arrival does no harm, or so the "Fight" staff member who took this picture assures me

● "If I were charging a levy on the petrol sold at London Airport [as many airports do] I should do quite well. There are various ways of charging, and, if all the methods are compared, I think that it will be found that the charges at London are not higher than those at major airports."—Mr Peter Thorneycroft, Minister of Aviation, November 21.

"A Boeing 707 landing [at London] after a transatlantic flight pays £182, which will go up to £243 next year. . . . At Montreal the corresponding landing fee is £145 for a transatlantic 707, at New York's Idlewild airport £43, at Chicago £19, and at San Francisco £17."—*The Times*, November 24.

● The following is an extract from "Straight and Level" of February 14, 1958:—

"Collectors of curious facts will be interested in the following item from a recent DH publicity release:—

'Comets have flown 20 million miles, equal to 800 times round the world or a fifth of the distance from Hyde Park Corner to the Sun.'

"Fortunately, DH are grown-up enough to laugh at themselves; and I hope that this quotation will appear, without comment, on the famous back page of the *de Havilland Gazette*."

* * *

Well, it never appeared on the famous funny page of the *de Havilland Gazette*. But perhaps this one, issued last week, will:—

"In two years of operation on the world's air routes Comet jet airliners have flown some 50 million miles, the equivalent of about 2,000 circuits of the world—or more than half the distance from London Airport (North) to the sun."

The head of Straight and Level's statistics department, Dr Otto Norm, comments:

"The change of datum from Hyde Park Corner to London Airport (North) appears to load the calculation in favour of the Comet, since London Airport (North) is nearer the sun during the autumnal equinox by $0.2693\ 10^{-7}$ tan θ nautical miles. However, I am convinced that the statement is, broadly speaking, accurate and certainly it is a splendid way of illustrating the good work that Comets have done during the past two years."

Man For The Job

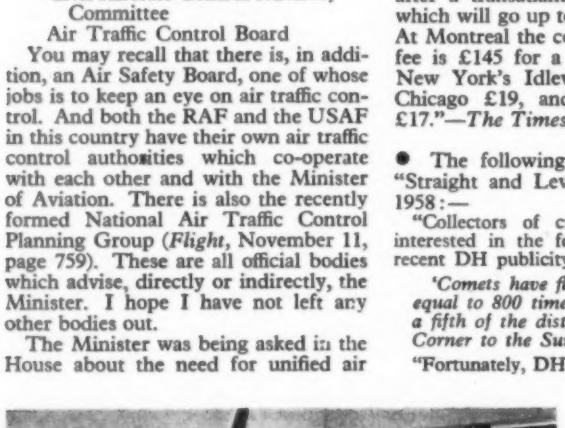
● STOP PRESS: The Minister of Football today announces the appointment of Mr J. Smith as Deputy Secretary in the Ministry of Football. He succeeds Sir Norman Languish, who is retiring from the public service.

Biographical Notes:—

Mr J. Smith is qualified aeronautical engineer and test pilot, specializing in aerodynamics, aeroelasticity, missile guidance, thermodynamics, hydraulics, electronics and plastics, and he has wide experience in the field of air transport operations and economics.

Mr Smith also brings to the Ministry of Football the experience he gained when, some years ago, he played scrum half for Orpington Extra "C."

ROGER BACON



I thought that this particular picture might be rather appropriate for "Flight's" special airports issue—an aircraft (Chrislea Ace) ground-support and maintenance system

Can we Make our Airports Pay?

By M. J. HARDY

"Flight" photograph

LAST week it became known that an investigating sub-committee of the Commons Select Committee on estimates will examine the proposed 1960-61 expenditure on Britain's airports. Reviewed in this article are some of the background economics of this much-debated subject.

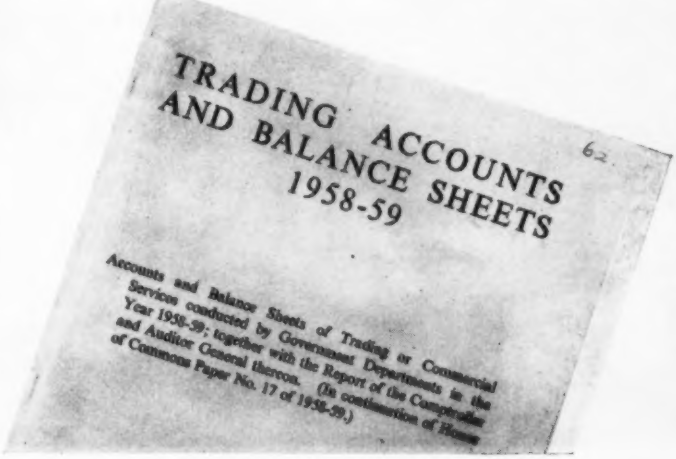
"MINISTRY philosophy is directly responsible for the virtual strangulation of all civil aviation except the scheduled airlines in Great Britain, and its actions and policies have a pronounced effect on international non-airline aviation." Who said that? A disgruntled British private owner? A mere taxpayer? If so, he might easily have been discounted as being too biased; but the author of these words (in a letter to the *Sunday Times* of July 19, 1959) was none other than Max Karant, vice-president of the Aircraft Owners and Pilots Association, and one of the most respected names in American general aviation. His remarks underline what is undoubtedly the root cause of the unsatisfactory financial position of Britain's airports—under-utilization. And although Mr Karant was referring to the old MTCA, his remarks are still valid in the context of the MoA's recently announced intention to increase landing fees again as from next April by amounts averaging one-third. This will, it is hoped, reduce substantially the deficit of £6,366,247 on airports and facilities incurred during the financial year ended March 31, 1959.

Not surprisingly, the latest landing fee increases are viewed with dismay by airlines using British airports and BEA may now, they say, have to reconsider their plans for lower fares. As so often happens when a Government department comes between producer and consumer, the latter comes off second best. The present British landing fees are the highest in the world except for those of the Sudan and are calculated as follows: (1) aircraft not exceeding 21,000lb, 6s per 1,000lb; (2) 21-26,000lb, £6 6s; (3) 26,000-200,000lb, £6 6s plus 5s 9d per each 1,000lb exceeding 26,000lb; (4) over 200,000lb, £56 6s plus 6s 6d per each 1,000lb exceeding 200,000lb. In addition, there are very short-haul rebates, ranging up to 80 per cent for stage lengths up to 25 st miles. There are also surcharges for aircraft bound for destinations outside Europe, Iceland or the Azores of 100 per cent minus £5 for aircraft of 40,000lb-80.000lb, and 100 per cent minus £3 for aircraft exceeding 80,000lb. Expressed more simply, the current landing fees and passenger service charges bring in £243 13s 6d revenue for a 707 Intercontinental landing with 165 passengers aboard, or £57 for a Viscount 800 landing with a load of 75 passengers.

As discussed in greater detail by G. L. Marchault in *Flight* of April 17, 1959 (from which article the above figures are taken) landing fees and other airport charges abroad are in many cases just as complicated as this country's; in some instances they border on the eccentric. Most countries use the aircraft's weight as a basis for landing fees, although there might be a case for taking a stage further the Portuguese concept of charging by horse-power and charging not by jet thrust, but by jet noise, particularly for night jet operations.

The idea of charging by weight is logical, since heavier aircraft need longer and stronger runways, and a big international airport has to have the best navaids and facilities. But costs of services and facilities can only be covered by intensive utilization, and for a country like Britain where domestic air transport is not yet on a very intensive scale, this presents a problem. Charging by weight bears more hardly on an operator like BEA, faced with severely seasonal traffic demands, and to whom the landing fee on a Viscount 800 represents the revenue from two or three night tourist seats on a flight from Amsterdam or Paris or similar high-frequency routes. To the big jet operator who comes into London perhaps only three times a week, the landing fee is far more bearable because it is less than the price of one return economy ticket. The current system takes no account of frequency of operation; it reflects the essentially static philosophy of merely charging what movements there are, rather than trying to stimulate the number of movements and increase utilization by reducing the fees for off-peak, off-season periods. The idea of rebates for frequency is not new: several countries already offer reductions to airlines making a number of landings at the same airport in one month. In Colombia no less than a 75 per cent reduction is available to an operator making more than 20 landings in a month, and there are over 60 domestic airlines in

The £ s d of Britain's airports can be scrutinized each year in the official ledger depicted here. The 1959-1960 edition is yet to appear


TRADING ACCOUNTS
AND BALANCE SHEETS
1958-59
Accounts and Balance Sheets of Trading or Commercial Services conducted by Government Departments in the Year 1958-59; together with the Report of the Comptroller and Auditor General thereon. (In continuation of House of Commons Paper No. 17 of 1958-59.)

AIRPORTS AND GROUND EQUIPMENT

Can we Make our Airports Pay? . . .

Colombia. With that country's relatively poor surface communications, air transport plays an important part in the Colombian economy, and a rebate of this order tends to encourage operators to develop "social service" type networks in the more sparsely populated regions.

Weight should not be the sole criterion of landing charges; frequency of operation must also be taken into account. It is unreasonable that airlines which have developed a whole complex structure of off-peak, off-season promotional fares to persuade people to travel during the slack traffic periods should be penalized by a system of landing charges which gives no incentive to them to use British airports during such periods, and does not reward the carrier whose promotional fares bring in extra tourist revenue to the country. It is still more unreasonable that BEA should feel compelled to reconsider plans for lower fares by the latest landing fee increases, for this is a situation in which higher charges threaten to lead to a decrease in revenue by driving away business. *Wings Over Westminster*, the Bow Group report on British air transport published earlier this year, states that there is no evidence that landing fee increases have turned traffic away; this situation may no longer prevail next summer, however. In the last few years at least one operator, the Flying Tiger Line, has moved its European operations base from London to Frankfurt mainly because of LAP's high rents for office space, charges for services rendered and the high cost of fleet maintenance. And it is hardly surprising that newly-formed contract charter carriers like Seven Seas Airlines or American International Airways started working from Schiphol and Melsbroek rather than LAP.

Wings Over Westminster, discussing the need for better airport utilization, puts forward the idea of a premium charge for using airport facilities at the daily peak period in the summer, on the grounds that facilities which have to be geared to handle peak traffic are under-utilized in off-peak periods. A *discount* for the operator using off-peak facilities would surely be better; and airline experience could be put to good use in developing off-peak, off-season discounts similar in purpose to promotional air fares.

At present, the airlines have no say in the charges levied at Ministry airports, although the Scheduling Committees representing all operators using each of the major airports are informed by the Ministry of the capacity available at various times, the operators then deciding between themselves how this can be allocated among them. A much more promising line of attack on the problem of airport insolvency would be for the Ministry to say: "We need x thousand more movements this year to make this airport pay. Would you be ready to schedule more off-peak, off-season services if landing fees and perhaps other charges as well were reduced for these periods?" A process of bargaining between airport and user could then begin which, although it would result in a compromise, would give airlines some say in determining airport charges instead of being made to feel, as at present, the victims of a "put-the-fees-up" philosophy.

Obviously this line of attack can be carried only so far: not even the most drastic reductions in charges would make it economical to schedule capacity when there is insufficient traffic. *Wings Over Westminster* stresses the desirability of developing non-seasonal business traffic on domestic routes: some airports for which domestic traffic is important, such as Leeds/Bradford, have in fact shown considerable increases in passengers handled during the first half of this year. Much more utilization will be achieved as British executive flying really gets into its stride and general aviation in this country begins to assume the importance it does in America.

It is in this field that the real improvements in British airport utilization and finance must come, for not even the USA, which carries over half the world's scheduled air traffic, can rely solely on airline revenue to make its airports financially self-supporting; general aviation provides about half the total traffic at US airports, and the majority of these show a profit. By contrast, executive and non-scheduled aircraft have never been encouraged to use London Airport; prior permission has to be obtained, this being given only in exceptional cases and when traffic permits. Since August single-engined aircraft or those engaged in operations of a "recreational nature" cannot be accepted and non-scheduled aircraft will not normally be allowed to use the north terminal apron. Those wanting to can use the central terminal outside specified hours subject to traffic, and "special restrictions" will be enforced during the Christmas, Easter, Whitsun and August holiday periods. As if all this was not enough, at least 24 hours' notice is required for prior permission, which demands 14 items of information, including whether a crew member can speak and understand English. All this leaves one with a feeling that the Ministry cherishes a secret, subconscious image of the average British private pilot as a rich, impetuous young man with a taste for adventure, a sort of airborne Bulldog Drummond who will, given half a chance, pursue his life, his loves and his enemies straight through the sacred precincts of Amber One. Certainly the misconception that private flying is of purely recreational value seems to be the basic reason for its comparative neglect in this country.

But as the use of executive aircraft grows, the already strong case for an independent body for controlling the operation and finances of British airports would grow too. Such a body might be based on the Port of London Authority, and would run airports if possible at a profit, raising capital by the issue of long-dated, fixed-interest stock. Amsterdam's airport is run as a limited liability company, N.V. Luchthaven Schiphol, the shareholders being the State and the municipalities of Amsterdam and Rotterdam. The board of directors numbers six government

". . . in favour of removing the 'temporary' buildings at LAP North, and providing accommodation adequate for big jet loads" "Flight" photograph

Prestwick, Scotland's intercontinental airport and transatlantic alternate, handles more transit passengers than any other UK airport. It is also the most fog-free

representatives, four from Amsterdam and one from Rotterdam. Any British equivalent would need to include representatives of the airlines, navaid and aircraft manufacturers (particularly of executive aircraft) and interested government departments such as the Treasury, Ministry of Aviation and Board of Trade. The importance of reconciling high utilization and safety would be recognized by including a representative of the Guild of Air Traffic Control Officers, while other bodies interested in general aviation such as the Royal Aero Club and Air League could also have a voice.

Air traffic control representation is particularly important and it seems entirely unreasonable that acceptance or refusal of a movement into or out of any British airport is always the function of administration. Making this point in a letter in *Flight* for September 11, 1959, Mr K. I. Pearson, Master of the Guild of Air Traffic Control Officers, goes on to say: "Of course, ATC handling capacity could be a factor in this consideration; but on movements alone I do not think this has yet intruded, as nowhere to our knowledge is there an ATC unit incapable of accepting a greater load . . . Very often we regret that at times we are not permitted to serve more people in the air, particularly the small operator and the private flier." This quietly disposes of the time-honoured argument that traffic density would make it impractical to throw open our major airports to large-scale executive use, and points the moral that administrative convenience rather than traffic density can determine an airport's utilization. The traffic density argument is really in the same category as the idea that competition from the independents would undermine the corporations' competitive positions; it has been repeated so often that people have stopped asking themselves whether it still applies to present-day conditions.

Learning from American Experience

Although our air traffic control facilities have rightly attracted international admiration, and enable the smaller African and Asian carriers to operate into London with complete confidence, we can learn a great deal from the Americans in how to achieve both safety and high utilization. To quote the AOPA: "The British frequently dominate international conferences on the contention that they're experts on traffic density, congestion, need for control, etc." But London Airport's peak traffic volume of about 600 movements a day is less than Idlewild's peak of about 650, and less than half that of Chicago's Midway Airport—the busiest in the world—which has a peak of about 1,400 daily movements, a quarter of which are private aircraft. At both Idlewild and Midway private aircraft, providing that they have radio, can land without prior permission at any time of any day. The same is true of La Guardia and Teterborough, NJ; even though the latter is devoted exclusively to business aircraft, with no airline operations, it has about twice as many movements as London. On its busiest day in 1959, Midway handled no less than 1,694 movements, or one every 51 seconds throughout the 24hr period; whilst Winston-Salem, NC, served by only three carriers (Capital, Eastern and Piedmont), was nearest to LAP's total with a score of 129,610 movements, ranking it 82nd among US airports in movements handled.

These figures show that the question is not so much whether we should encourage private aircraft to use British airports as how many could be safely accepted by the existing air traffic control machinery. If Midway (Chicago) can count some 25 per cent of its peak movements as private aircraft, then surely London Airport can at least try to achieve a similar proportion in due time. Unless Croydon is reopened, the Ministry of Aviation must be prepared to think in terms of as many as 150 private aircraft movements per day at LAP eventually during peak periods—a staggering total by present British standards, but not by American ones. It may well be objected that there are simply not enough privately owned aircraft in this country to sustain such a figure even if there were no restrictions. But during 1959 alone about 60 US and European light aircraft were imported for British owners, and future production from the Beagle concern, allied to foreign imports which show no signs of slacking off, will not make a figure of 150 daily movements so improbable in a few years' time. This cannot be achieved by production alone; other factors—in particular, more suitable radio and greater freedom of airspace, with the necessary piloting skill to use them properly—must play their part. At current rates, a landing fee for a 7,000lb light twin would be 42s, and revenue from this source alone could eventually top the £200 mark on a peak day, not counting the revenue that could be obtained from fuel and oil, from use of various concessions, and from car-parking fees paid by visitors to the airport.

At the moment, however, this potential business is being turned away, and the Ministry of Aviation is unable to give any forecast of when the 15 principal UK state-owned airports will become financially self-supporting. Neither does the Treasury see any hope of avoiding further substantial deficits over the next few years. This apathetic, defeatist attitude is perhaps the strongest argument in favour of an independent body running Britain's airports on commercial lines, for no commercial undertaking could afford merely to shrug off the prospect of apparently indefinite future deficits. If it seriously wants Britain's airports to pay (and one may be pardoned for doubting this) the Ministry will have to abandon its tax-collector mentality in favour of an entirely new attitude: that of the successful hotelier or restaurateur who knows that he can only attract and retain new custom by giving value for money, and charging reasonable prices. British airports seem to have suffered both financially and operationally as a result of Treasury/Civil Service systems of control and annual budgeting, and in particular by being for so long the concern of a Ministry that also had heavy commitments in road-building and other surface transport projects.

London Airport's Late Start

It was not until two years and eight months after the Millbourn Committee report on London Airport recommended a new long-haul terminal that the Ministry of Aviation finally approved plans for this badly-needed facility and construction began. If LAP had been run, like Schiphol, as a limited liability company it could have raised capital and at least have made a start on new long-haul facilities much earlier. As it was, the latter had to compete, not only with a multiplicity of other surface transport projects for a share of funds, but with the development of Gatwick. It would surely have been wiser to have postponed the latter in favour of removing the "temporary" buildings at LAP North, and providing accommodation adequate for big jet loads. Indecision, as well as lack of funds, has slowed down London Airport's development: it has still to be finally decided whether or not to connect the terminal with aircraft by means of fingers. A commercial body is hardly likely to have taken the best part of three years making up its mind; it would have recognized the urgency of making the necessary decisions and getting construction as far advanced as possible before large-scale jet operations began. It would have recognized, too, that fingers-versus-mobile lounges was a comparatively minor issue compared to the urgent necessity of coping adequately with jet loads of 100 or more passengers, for although the final solutions may be outdated even before completion (for airport design develops rapidly, like aircraft design) nobody expects them to be perfect.

In conclusion, it is worth quoting again from Max Karant's letter in the *Sunday Times*: "No matter how the Ministry theorizes on that much-maligned, outrageously-exaggerated subject of safety, there is only one way the British Government will ever overcome the fantastic costs of London Airport, and other British airports—more and more business."

FACTS AND FIGURES about Britain's principal airports are included in the tabulated lists of international airports on pages 907-911 of this issue.

AIRPORTS AND GROUND EQUIPMENT

THE EXPANDING GIRDLE

By G. L. Marchault

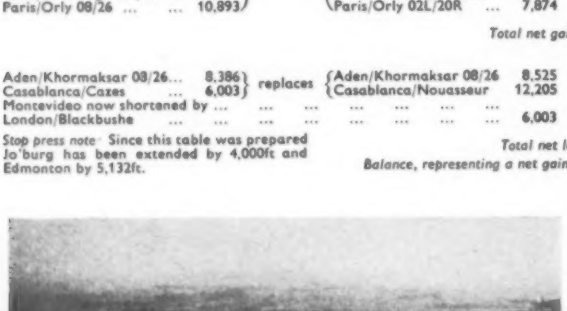
"I'll put a girdle round about the earth in forty minutes"
***—A Midsummer Night's Dream*, Act 2, Scene 1**

ALTHOUGH the heavy airport demands of the big jets have been with us since 1956, there were few countries up to the end of 1959 which had done much to cater for their needs. Then *Flight* estimated that about 750,000ft of extra runway would be required to bring an adequate number of airports up to a standard sufficient to permit the safe operation of Boeing 707s and DC-8s. During 1959 the programme had got under way with almost painful slowness; by the end of the year about six per cent of the estimated total had been built.

During the last twelve months the building programme has gathered momentum. Nine entirely new airports have come into existence, others have been replaced by new or rebuilt versions, several others have new runways of greater length, whilst one or two have dropped out. Progress can best be portrayed by a form of balance sheet:—

Airport or runway	Length (ft)		Airport or runway	Length (ft)	Net gain
Brasilia	7,874		—	—	7,874
Jonkoping (Sweden)	5,250		—	—	5,250
Kiruna (Sweden)	5,570		—	—	5,570
Palma/Son San Juan	7,874		—	—	7,874
Porto Santo, Madeira	5,284	... new airports ...	—	—	5,284
Rome/Fiumicino	12,795		—	—	12,795
Sao Paulo/Viracopos	10,630		—	—	10,630
Stockholm/Arlanda	10,826		—	—	10,826
Tahiti	6,232		—	—	6,232
Abadan 14R/32L	7,094		Abadan 14L/32R	6,002	1,092
Bogota/El Dorado	12,467		Bogota/Techo	7,284	5,183
Brussels National 08L/26R	11,942		Brussels National 02/20	9,258	2,684
Ciudad Trujillo	8,364		General Andrews	7,000	1,364
Dakar/Yoff 01/19	9,512		Dakar/Yoff 12/30	7,906	1,606
Guernsey	4,800	replaces	Guernsey	3,500	1,300
Lima/Callao International	11,482		Lima/Limatambo	6,504	4,978
Milan/Malpensa 17L/35R	12,840		Milan/Malpensa 17R/35L	8,622	4,218
Montreal/Dorval 06R/24L	9,600		Montreal/Dorval 06/24	7,000	2,600
Moscow/Sheremetievo	11,480		Moscow/Kubinka	8,202	3,278
Paris/Le Bourget 07/25	9,843		Paris/Le Bourget 03/21	8,743	1,100
Paris/Orly 08/26	10,893		Paris/Orly 02L/20R	7,874	3,019
			Total net gain		104,757
					Net loss
Aden/Khormaksar 08/26	8,386	replaces	Aden/Khormaksar 08/26	8,525	139
Casablanca/Cazes	6,003		Casablanca/Nouasseur	12,205	6,202
Montevideo now shortened by					163
London/Blackbushe				6,003	6,003
			Total net loss		12,507
			Balance, representing a net gain of		92,250

Stop press note: Since this table was prepared Jo'burg has been extended by 4,000ft and Edmonton by 5,132ft.



Apart from the building of completely new airports or runways there has been considerable runway-extension activity. This work has been going on all over the world, but here we are only concerned with the 250 airports tabulated in the following pages. No fewer than 37 have notified increases in runway length ranging from 130ft at Washington DC to 4,270ft at Geneva/Cointrin. Major increases were registered at Frobisher Bay, Jeddah, Idlewild, Orly and Vienna/Schwechat, all of which were increased by 3,000ft or more, whilst Bombay/Santa Cruz, Chicago/O'Hare, Curaçao/Dr A. Plesman, Los Angeles, Niamey, Prestwick and Rio de Janeiro all gained 2,000ft or more.

Hand in hand with runway extensions went the work of strengthening. The new runway at Aden/Khormaksar increased its LCN (Load Classification Number) from 35 to 50. Baghdad was raised by 100,000lb a.u.w., Bangkok became stronger in the dry weather but weaker in the wet; Bremen, Brussels, Djakarta and Geneva all reported significant strengthening whilst Guam was nearly doubled and Memphis almost quadrupled in capacity. Other bearing strength increases were reported by Mombasa, Montreal, Niamey, Panama, Le Bourget and Santiago. A vast amount of work must have been done at Rio de Janeiro/Galeao, where the runway was breaking up under the impact of the heavy jets. Trinidad/Piarco has just embarked on a six-month programme of resurfacing, strengthening and recambering.

The overall cost of the work done in strengthening runways last year is impossible to estimate accurately. However, an estimate of £15 million might not be far off the mark. Cost of building new runways varies between £200 and £300 per foot, depending on the width, depth and type of construction. Runway extensions and extra runways between them accounted for nearly 179,000ft last year at a cost, say, of between £36m and £54m. The nine completely new aerodromes probably absorbed a further £75m. Thus, solely from among the airports listed, a total of between £126m and £144m was spent to make the world a simpler (albeit much noisier) place for the jets to live in.

At one time most people in this country, if asked to place London Airport in a table of comparative runway length, would have put it very close to the top of the table for the entire world. Even today, if asked to compile the same table exclusively for Europe, popular opinion might put it around fifth or sixth. In fact it is 21st. The present-day European runway league table looks like this:—

1. Milan/Malpensa	12,840ft	11. Beirut	10,662ft
2. Geneva	12,800ft	12. Keflavik	10,015ft
3. Rome/Fiumicino	12,795ft	13. Madrid	10,006ft
4. Zaragosa	12,140ft	14. Moscow/Vnukovo	10,006ft
5. Brussels National	11,942ft	15. Santa Maria, Azores	10,000ft
6. Frankfurt/Main	11,810ft	16. Budapest	9,875ft
7. Moscow/Sheremetievo	11,480ft	17. Paris/Le Bourget	9,843ft
		18. Turin/Caselle	9,842ft
8. Paris/Orly	10,893ft	19. Vienna/Schwechat	9,842ft
9. Copenhagen	10,826ft	20. Prestwick	9,800ft
10. Stockholm/Arlanda	10,826ft	21. London Airport	9,576ft

It is not without interest to check back on last year's list (*Flight*, December 4, 1959). Many plans have been translated into reality, but news is still awaited of work being started on the following:—
Extensions: Ankara, Athens,* Belem, Calcutta, Caracas,* Dusseldorf, Elisabethville, Guatemala,* Karachi,* Madrid,* Manila,* Mexico City (first notified 1958), Recife, Riga, Singapore, Tel Aviv, Tokio, Zurich.
New runways: Amsterdam,* Baltimore, Philadelphia, Prague, Saigon, Shannon, Vilnius.
New airports: Damascus, Edmonton, Kuwait, Melbourne and San Salvador.

Development for 1961 appears to be along the following lines:
1961 extensions: Barranquilla, Buenos Aires* (notified 1959, now begun), Colombo/Katunayake,* Frankfurt, Goteborg, Graz, Hamburg, Innsbruck, Johannesburg/Jan Smuts, London Airport, Madras,* Perth (W. Australia), San Juan* (work started), Sydney/Kingsford Smith, Tahiti,* Teheran, Warsaw.
1961 new runways: Accra,* Delhi* and Kabul* (all three notified in 1959—now started), La Paz,* Munich, Tokio, Toronto.
1961 new airports: Belgrade, Cairo.

Only the items marked * are derived from official information or from press reports which have later been confirmed officially.

(Concluded on page 914)

This is the third annual edition of "Flight's" tables of facts and figures about the world's international airports, some 250 in all. The assistance of the staff of the Aeronautical Information Service of the Ministry of Aviation is gratefully acknowledged. The AIS have used the latest information available to them, correct to December 2.

Airport	Main runway: QFU, Length × Width (ft) and Surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
Abadan, Iran	*14R/32L*, 6,002×196, A *14L/32R*, 7,094×115, A	176,000 a.u.w. (est) Not published	10	39.0 ART	*New R/W available day only—no lights yet*
Abidjan/Port Bouet, Fr W Africa	*03/21*, 8,856×164, T	Boeing 707, DC-8	20	29.2 ART	*R/W extended 1,638ft and strengthened (ex DC-7C)*
Accra, Ghana	*03/21*, 7,330×200, A	34,000 s.i.w.l. at 90 lb/sq in	221	29.3 ART	*New jet R/W of 9,600ft×200ft, LCN 70, under construction*
Adelaide	*04/22*, 6,850×200, GL	LCN 45	12	24.4 ART	
Aden/Khormaksar	*08/26*, 8,386×150, A	LCN 50	10	32 est	*New R/W stronger (old R/W LCN 35) but 137ft shorter*
Algiers/Maison Blanche	*06/24*, 7,972×197, C	99,210 s.i.w.l.	82	28.2 ART	
Amman	*06/24*, 8,000×150, A	LCN 60	2,498	32 est	
Amsterdam/Schiphol	*01/19*, 8,366×197, A-C	148,812 s.i.w.l.	−13	17.8 ART	*New R/W of 10,827ft and 150,000 s.i.w.l. reported in 1959 to be available in spring of 1960, but not yet complete*
Anchorage	*06/24*, 8,400×200, C	DC-7C	114	N.A.	
Ankara/Esenboga	*03/21*, 9,016×167, C	200,000 a.u.w.	3,096	23 ART	*Work in progress on 3,280ft extension*
Antigua/Coolidge Field, BWI	*07/25*, 5,800×150, C	C-118	26	23 est	
Antofagasta/Cerro Moreno, Chile	*18/36*, 6,725×165, C	C-124	448	20 est	
Asuncion/President Stroessner, Paraguay	*01/19*, 9,003×150, A	C-118, Comet 4	330	21 est	*Renamed—formerly Campo Grande*
Athens	*15/33*, 8,202×197, A	100,000 s.i.w.l.	90	29 ART	*12/10/59 financial approval to extend R/W to 9,870ft.* Reported 18/7/60 extension to be 10,500ft
Atlanta, USA	*09/27*, 7,860×150, A-C	120,000 single wheel 180,000 twin wheel 400,000 twin tandem	1,024	21 est	
Auckland/Whenupai	*04/22*, 6,590×150, C	LCN 35	100	19.7 ART	
Baghdad	*14/32*, 7,054×150, T	231,000 a.u.w.	112	36 est	*B/S raised from 130,000 a.u.w. New airport planned (notified in 1959)*
Bahrain	*12/30*, 7,500×200, T	55,000 s.i.w.l. at 114 lb/sq in	6	34 est	
Baltimore/Friendship	*10/28*, 9,450×200, A	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	146	24 est	Work approved in 1959 for new 10,000ft R/W
Bangkok/Don Muang	*03/21*, 9,840×197, C	Dry season 198,410 a.u.w. Wet season 132,280 a.u.w.	12	35 est	*B/S amended—was 140,000 a.u.w. all seasons*
Barbados/Seawell	*09/27*, 7,000×150, A-C	Stratocruiser	165	28.3 ART	
Barcelona	*07/25*, 8,366×328, A	77,160 s.i.w.l. at 120 lb/sq in	13	24.9 ART	
Barranquilla/Soledad, Colombia	*03/21*, 5,180×150, A	130,180 a.u.w.	47	23 est	*To be extended for jets (Economic report on Colombia, May, 1959)*
Basle/Mulhouse	*16/34*, 7,750×196, C	147,638 s.i.w.l.	882	21.5 ART	
Basra	*12/30*, 6,000×150, A	132,800 a.u.w.	8	34 est	
Beirut	*18/36*, 10,662×200, C	148,812 s.i.w.l.	85	15† ART	
Belem/Val de Caes	*02/20*, 5,970×200, A	DC-7C: max landing wt 109,000 & max t/o 142,600 for R/W 20. 141,112 max t/o wt for R/W 02	45	27 est	Press report June 1959 stated R/W was to be strengthened and extended to 9,840ft
Belfast/Nutts Corner	*10/28*, 6,014×150, C	LCN 40	359	16 ART	
Belgrade/Zemun	*04/22*, 5,249×262, C	44,090 s.i.w.l.	242	30 est	A new airport for Belgrade being built at Surcin, runway to be 9,840ft×197ft
Belize/Stanley Field, Br Hond	*07/25*, 5,000×150, A	80,000 a.u.w.	16	25 est	
Berlin/Templehof	*09R/27L*, 5,280×140, C	100,000 s.i.w.l.	163	20.6 ART	*Unlikely to be developed—in built-up area*
Bermuda/Kindley Field	*12/30*, 9,710×150, A-C	250,000 a.u.w	11	29 est	
Birmingham	*16/34*, 5,006×150, T	LCN 40	325	18 ART	*LCN raised from 30. No longer called Elmdon*
Biskra, Algeria	*13/31*, 5,577×148, A	44,090 s.i.w.l.	285	35.7 ART	
Bogota/El Dorado	*12/30*, 12,467×160, A-C	300,000 a.u.w.	8,355	14.8 est	*El Dorado replaces Techo (7,284ft×200ft, B/S Super Constellation). Techo now military A/F*
Bombay/Santa Cruz	*09/27*, 10,500×150, C	60,000 s.i.w.l.	27	30.8 ART	*R/W lengthened by 2,300ft*
Bone/Les Salines, Algeria	*01/19*, 6,414×131, A	44,090 s.i.w.l.	10	28.2 ART	
Bordeaux/Merignac	*114/294*, 7,877×197, C	110,230 a.u.w.	161	22.7 ART	

Abbreviations: R/W, runway; A, asphalt; C, concrete; Crl, coral; G, grass; GL, gravel; RS, rolled sand; T, tarmac; B/S, bearing strength; a.u.w., all-up (gross) weight; s.i.w.l., single isolated wheel load; LCN, load classification number; ART, airfield reference temperature (official figure—all other temperatures quoted are approximate "maximum mean" for hottest month of the year); est, estimated; NA, not available.

*Italic type in this column indicates *official* information and also relates to work done during the past twelve months. †Official figure, but seems extremely low.

Airport	Main runway: QFU, Length × Width (ft) and Surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
Boston/Logan	04R/22L, 10,023 × 205, A-C	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	19	22.5 est	
Brasilia/Brazil	10/28, 7,874 × 147, A	Boeing 707—t/o 261,284 lb—landing 207,000 lb	3,473	N.A.	*Originally a small airfield—now developed to international standards to serve new capital of Brazil*
Brazzaville/Maya Maya, Congo (ex-Fr)	06/24, 7,545 × 197, C	297,000 a.u.w.	1,044	27.3 ART	
Bremen	09/27, 6,262 × 160, C	88,500 s.i.w.l.	11	18.9 ART	*B/S increased from 60,000 s.i.w.l.*
Brindisi	14/32, 8,543 × 150, T	44,090 s.i.w.l. at 100 lb/sq in	42	29.3 est	
Brisbane/Eagle Farm	04/22, 7,760 × 200, C	LCN 60	7	26.7 ART	*LCN reduced from 70*
Bristol/Lulsgate	10/28, 4,232 × 150, T	LCN unknown	611	17 ART	
Brno/Turany, Czechoslovakia ...	10/28, 6,560 × 196, C	33,000 s.i.w.l.	781	8.5 ART	
Brussels National	08L/26R, 11,942 × 148, C	220,500 a.u.w.	180	19.4 ART	*New R/W. 2,684ft longer and 66,000lb stronger than previous best (02/20—9,258ft/154,322lb)*
Bucharest/Baneasa	07/25, 7,216 × 196, C	59,400 s.i.w.l.	297	25.2 ART	
Budapest/Ferihegy	13/31, 9,875 × 196, C	154,000 a.u.w.	440	20 est	*R/W has been extended by 1,837ft but night t/o is restricted to 7,545ft*
Buenos Aires/Ezeiza	10/28, 8,348 × 262	154,320 s.i.w.l. at 121 lb/sq in	68	25 est	*Work has started on R/W extension from threshold R/W 10. First reported last year*
Cairo International	05/23, 10,990 × 197, C	74,960 s.i.w.l.	311	31 ART	*R/W extended by 1,640ft.* Reported 20/6/60 that new International airport would be ready by end of 1961
Calcutta/Dum Dum	01/19, 7,700 × 150, C	45,000 s.i.w.l.—occasional 60,000	13	33.9 ART	*R/W extended by 700ft—planned for extension to 10,500ft*
Calgary	16/34, 8,675 × 150, A	DC-6	3,557	N.A.	Planned for extension to 12,000ft
Canberra	17/35, 6,800 × 150, GL	LCN 44	1,872	23.3 ART	
Canton	09/27, 6,000 × 150, C	150,000 a.u.w.	9	32 est	
Cape Town/D.F. Malan	01/19, 6,900 × 200, A	75,000 s.i.w.l.	151	22.3 ART	
Caracas/Maiquetia	08R/26L, 6,988 × 196, A	154,000 a.u.w.	131	25 est	Back in 1958 plans announced to lengthen R/W to 10,500ft but work does not seem to have started
Cardiff/Rhoose	04/22, 4,534 × 150, T	LCN 25	220	18 ART	
Casablanca/Cazes	03/21, 6,003 × 148, C	116,843 a.u.w.	203	24.6 ART	*Cazes has replaced Nouasseur and is not available to transit aircraft*
Chicago/O'Hare	14R/32L, 11,600 × 200, C	120,000 single wheel 200,000 twin wheel 375,000 twin tandem	667	24 est	*R/W has been extended by 2,762ft*
Ciudad Trujillo	16/34, 8,364 × 197, C	75,000 s.i.w.l.	57	24 est	*Replaces General Andrews, closed 1/12/59*
Cleveland/Hopkins	18/36, 6,421 × 200, A	100,000 single wheel 175,000 twin wheel 310,000 twin tandem	789	23 est	*R/W extended by 179ft*
Cocos	15/33, 8,000 × 150 Crl	LCN 45	11	28.3 ART	
Cologne/Bonn	07/25, 8,000 × 150, C	65,000 s.i.w.l.	267	19.4 ART	*Building new R/W 14L/32R. Reported to be 12,480ft*
Colombo/Katunayake	04/22, 6,000 × 300, C	LCN 40	28	29 est	*To be developed to international standards and extended to 8,700ft*
Colombo/Ratmalana	04/22, 6,013 × 150, A	30,000 s.i.w.l.	22	29 ART	
Copenhagen/Kastrup	04/22, 10,826 × 151/262, C	220,500 twin wheel 312,000 twin tandem	16	18.8 ART	*R/W lengthened by 1,640ft*
Cork	6,000 × 150, C	N.A.	520	N.A.	*New airport, due in service May 1961*
Curacao/Dr Albert Plesman ...	11/29, 10,500 × 200, A-C	In excess of LCN 100	26	25 est	*R/W has been lengthened by 2,563ft*
Dakar/Yoff, Senegal	007/187, 9,512 × 148, C	Boeing 707, DC-8	56	28.6 ART	*New R/W*
Dallas/Love	13/31, 7,751 × 150, C	100,000 single wheel 150,000 twin wheel 330,000 twin tandem	485	24 est	
Damascus/Mezze	06/24, 8,235 × 197, A	44,090 s.i.w.l.	2,405	21 ART	*Construction of new Damascus International (the first United Arab Republic development) does not appear to have started. Site at Marj el Sultan, 17km from Damascus—estimated building time 3 years*
Darwin	10/28, 9,570 × 200, C	LCN 90	86	31.1 ART	*R/W lengthened by 510ft*
Delhi Palam	09/27, 7,500 × 150, T	17,000† a.u.w.	744	36 ART	*New R/W of 10,500ft under construction*
Denver Stapleton	08R/26L, 10,010 × 150, A	120,000 single wheel 200,000 twin wheel 375,000 twin tandem	5,331	22.1 est	
Detroit Metropolitan Wayne County	03L/21R, 10,500 × 200, C	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	639	20 est	
Dhahran	17/35, 10,000 × 200, A	300,000 a.u.w.	78	30.2 ART	
Djakarta/Kemajoran	17/35, 8,120 × 197, A	60,000 s.i.w.l.	16	26.9 est	*Bearing strength raised from 60,000 a.u.w. to s.i.w.l.*
Djibouti	091/271, 7,872 × 148, T	DC-7C	46	36.6 ART	
Dublin	06/24, 5,288 × 200, C	51,000 s.i.w.l.	222	19 est	
Durban/Louis Botha	05/23, 6,800 × 200, T	75,000 s.i.w.l.	25	25.2 ART	
Dusseldorf	06/24, 8,380 × 150, C	77,000 s.i.w.l.	133	19.7 ART	*R/W extended by 260ft.* Plans reported in 1959 for extending to 12,800ft × 200ft
Edinburgh/Turnhouse	13/31, 6,000 × 150, T	LCN 30	135	16 ART	
Edmonton/New International, Canada	01/19, 11,000 × 200, C	Unknown	2,373	15 est	New international airport
Elisabethville, Congo	075/255, 7,872 × 164, T	59,520 s.i.w.l.	4,185	25 ART	
El Paso	04/22, 9,043 × 150, A	90,000 single wheel 180,000 twin wheel 360,000 twin tandem	3,936	27.9 est	
Entebbe	12/30, 9,875 × 200, T	LCN 37	3,789	24 ART	
Fiji/Nadi	03/21, 10,500 × 150, C	LCN 70	63	28.1 ART	
Fort Lamy, Tchad	050/230, 7,546 × 131, T	154,000 a.u.w.	968	33.3 ART	
Fort Worth/Greater Fort Worth International	13/31, 8,450 × 200, C	120,000 single wheel 180,000 twin wheel 400,000 twin tandem	568	25 est	

Airport	Main runway: QFU, Length × Width (ft), and Surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
Frankfur/Main	*07L/25R*, 11,810×196, C	100,000 s.i.w.l.	368	20.9 ART	*07R/25L to be extended to 9,850ft (+3,840ft). Main R/W to be extended by spring of 1961*
Frobisher Bay	*18/36*, 9,000×200, A	DC-6 (?)	96	15 est	*R/W has been extended by 3,000ft*
Gander	*14/32*, 8,600×200, A	Boeing 707-120	496	17 est	
Geneva Cointrin	*05/23*, 12,800×164, C	136,690 s.i.w.l.	1,410	20.6 ART	*R/W has been extended by 4,270ft and B/S raised from 79,500 s.i.w.l.*
Georgetown/Atkinson Field, British Guiana	*05/23*, 7,430×250, C	200,000 a.u.w.	96	25 est	
Gibraltar	*09/27*, 6,000×150, A	60,000 s.i.w.l. at 100 lb/sq in	15	24.4 est	
Glasgow Renfrew	*08/26*, 5,789×150, T	LCN 35	42	16 ART	*To be replaced by Abbotsinch 1963?*
Goteburg/Torslanda	*04/22*, 5,970×196, A	44,090 s.i.w.l.	13	18.5 ART	Press reports proposal to lengthen two runways to accommodate jet aircraft
Graz, Austria	*17/35*, 4,920×147, C	44,000 s.i.w.l.	1,110	20.3 ART	Reported R/W to be extended to 6,560ft
Guam/Agana City	*06L/24R*, 8,000×150, C	100,000 single wheel 200,000 twin wheel 350,000 twin tandem	280	20.8 est	*B/S raised—previously 150,000 a.u.w.*
Guatemala La Aurora	*01/19*, 6,960×200, A	C-124	4,952	20.8 est	*R/W to be extended for jet aircraft*
Guayaquil Simon Bolivar	*02/20*, 6,030×150, A	DC-7	13	30 est	
Guernsey	*10/28*, 4,800×120, A	LCN unknown	330	18 ART	*New R/W—previously 3,500ft of grass*
Halifax, Nova Scotia	*06/24*, 8,800×200, A	Super Constellation	476	N.A.	
Hamburg	*05/23*, 9,055×210, C	60,000 s.i.w.l.	45	18.8 ART	*R/W lengthened by 1,644ft and widened by 60ft. Planned for extension to 11,800ft (?)*
Hannover	*10/28*, 7,678×150, C	77,000 s.i.w.l.	179	19.2 ART	Press reports new R/Ws to be built
Havana Jose Marti	*05/23*, 7,063×150, A	C-124	208	25 est	
Helsinki	*04/22*, 6,560×196, A	154,000 a.u.w.	167	18.5 ART	
Hong Kong International	*13/31*, 8,350×200, T	LCN 100	15	29.7 ART	
Honolulu International	*08/26*, 12,400×200, A	200,000 twin tandem	10	29.5 est	
Houston	*03/21*, 7,600×150, C	60,000 single wheel 90,000 twin wheel 200,000 twin tandem	50	26 est	*R/W has been extended by 1,034ft*
Innsbruck	*08/26*, 6,160×131, C	110,000 a.u.w.	1,906	20.1 ART	*R/W extended by 321ft.* Press reports further extension probable
Istanbul Yesilkoy	*06/24*, 7,540×167, C	200,000 a.u.w.	79	23.2 ART	
Jeddah	*09/27*, 9,400×150, T	129,000 a.u.w.	50	31.1 est	*R/W lengthened by 3,355ft*
Jersey	*09/27*, 5,100×150, T	LCN unknown	276	18 ART	*R/W lengthened by 350ft*
Johannesburg Jan Smuts	*03/21*, 14,500×200, T	135,000 s.i.w.l.	5,559	21.3 ART	*R/W extended by 4,000ft*
Jonkoping/Axamo, Sweden	*12/20*, 5,250×150, A	44,092 s.i.w.l.	741	17.5	*New airfield. To be opened about 1/2/61*
Kabul	*15/33*, 4,700×250, G	Not tested, varies with saturation	5,795	N.A.	*New 11/29 R/W under construction*
Kano	*07/25*, 8,610×200, T	60,000 s.i.w.l. at 100 lb/sq in	1,563	30.5 est	
Kansas City, Missouri	*18/36*, 7,000×150, C	110,000 single wheel 165,000 twin wheel 365,000 twin tandem	758	21 est	
Karachi	*07/25*, 7,500×150, A	7 tons/sq ft	75	31 ART	*New 07/25 R/W to be 10,500ft (1/2/61)*
Keflavik	*12/30*, 10,015×200, A	63,000 s.i.w.l.	169	4.6 ART	Reykjavik unsuitable for jets
Khartoum	*18/36*, 7,050×150, T	44,092 s.i.w.l.	1,253	32.6 est	
Kingston Palisadoes, Jamaica	*11/29*, 7,600×150, A-C	155,000 tandem 300,000 twin tandem	10	29 ART	
Kiruna, Sweden	*03/21*, 5,570×147, A	44,000 s.i.w.l.	1,450	16.5 ART	*New airfield. Opened 10/11/60*
Kuala Lumpur	*04/22*, 6,200×150, T	LCN 40	111	28.8 ART	
Kuwait	*14/32*, 5,460×150, T	130,000 a.u.w.	20	38.2 est	*Plans exist for new international airport*
Lagos	*01/19*, 7,600×150, T	51,000 s.i.w.l. at 100lb/sq in	132	28 est	
La Paz El Alto	*09/27*, 11,087×394, GL	C-118	13,402	18.6 est	*New paved R/W of 10,800ft to be built—no date given for start of work*
Leopoldville/Ndjili	*07/25*, 15,416×197, C	99,000 s.i.w.l.	1,014	27.6 ART	*Temporarily (?) closed by Congolese authorities*
Lima Callao International	*14/32*, 11,482×147, A	Boeing 707 trans-continental at max	105	N.A.	*Officially opened 31/10/60 as replacement for Lima/Limatambo*
Lisbon/Portela	*04/22*, 6,824×164, C	77,160 s.i.w.l.	360	24 ART	
London Airport	*10R/28L*, 9,576×300, C	LCN 100	80	19 ART	*R/W 10R/28L out of service since September for extension to 11,000ft by April*
London Gatwick	*09/27*, 7,000×150, C	LCN 75	194	18 ART	
Los Angeles	*07R/25L*, 12,000×200, A	150,000 single wheel 200,000 twin wheel 400,000 twin tandem	126	20 est	*R/W has been extended by 2,000ft*
Lusaka	*08/26*, 6,660×70, GL	LCN 50	4,208	27.6 ART	
Luxembourg	*07/25*, 9,284×197, A	220,500 s.i.w.l.	1,239	N.A.	
Madras	*07/25*, 6,000×150, T	30,000 s.i.w.l.	34	33.6 ART	*R/Ws to be extended—no details available*
Madrid/Barajas	*15/33*, 10,006×295, C	110,230 s.i.w.l. at 120lb/sq in	1,985	28 ART	*R/W to be extended eventually to 13,450ft*
Malmo/Bulltofta	*06/24*, 5,905×196, A	44,090 s.i.w.l.	16	18.5 ART	
Malta Luqa	*06/24*, 6,000×150, T	70,000 s.i.w.l.	297	27 ART	*Being extended to 7,800—due 30/4/61*
Manchester	*06/24*, 7,000×150, A	LCN 65	256	17 ART	*R/W has been extended by 1,100ft*
Manila/Manila International	*13/31*, 7,954×100, A *06/24*, 7,500×200, A	35,000 s.i.w.l. 75,000 s.i.w.l.	67	27.7 est	*Planned extension to 10,000×150ft. Night landings prohibited for Boeing 707 and DC-8*
Maracaibo/Grano de Oro	*04L/22R*, 6,250×200, A	77,000 a.u.w.	131	25 est	
Marseille Marignane	*14L/32R*, 7,874×148, C	66,140 s.i.w.l.	66	25.7 ART	
Melbourne	*07/25*, 6,100×200 GL	LCN 30	260	21.7 ART	New airport planned at Tullamarine with N-S R/W of 10,000ft and NE-SW R/W of 8,000ft
Memphis	*09/27*, 8,905×150, A	100,000 single wheel 200,000 twin wheel 400,000 twin tandem	291	N.A.	*B/S strength revised—was 100,000 a.u.w.*
Mexico City	*05R/23L*, 9,840×149, A	Britannia 300	7,340	24.5 est	Airport to be enlarged and main R/W extended to 14,000ft. High-intensity lighting and new surveillance radar to be installed
Miami International	*09/27*, 9,400×200, A	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	9	30.3 est	
Milan Malpensa	*17L/35R*, 12,840×197, T-C	99,210 s.i.w.l. at 107lb/sq in	764	25.3 est	*New R/W opened 14/11/60. Increases effective length by 4,218ft*
Mombasa/Port Reitz	*09/27*, 6,200×120, T	82,000 a.u.w.	186	30 ART	*R/W extended by 200ft, B/S raised from 60,000 a.u.w.*
Montego Bay, Jamaica	*06/24*, 7,100×150, A	Stratocruiser	3	29 ART	
Montevideo	*05/23*, 6,889×147, A	235,500 a.u.w.	75	18 ART	*R/W now 163ft shorter*
Montreal Dorval	*06R/24L*, 9,600×200, A	DC-8	104	22.7 est	*New R/W. (Previously 7,000×200ft and DC-7B)*
Moscow/Sheremetievo	*07/25*, 11,480×262, C	N.A.	623	23 est	*Sheremetievo replaces Vnukovo, which reverts to alternate status. Kubinka no longer available*
Moscow/Vnukovo	*02/20*, 10,006×197, C	N.A.	669	23 est	
Munich/Riem	*07/25*, 8,530×197, C	99,200 s.i.w.l.	1,732	19.9 ART	New R/W to be constructed
Nairobi	*06/24*, 10,000×150, A	LCN 100	5,327	23.1 ART	
Naples/Capodichino	*06/24*, 7,218×197, T-C	77,160 s.i.w.l. at 107 lb/sq in	288	27 est	

Abbreviations: R/W, runway; A, asphalt; C, concrete; Crl, coral; G, grass; GL, gravel; RS, rolled sand; T, tarmac; B/S, bearing strength; a.u.w., all-up (gross) weight; s.i.w.l., single isolated wheel load; LCN, load classification number; ART, airfield reference temperature (official figure—all other temperatures quoted are approximate "maximum mean" for hottest month of the year); est, estimated; NA, not available.

*Italic type in this column indicates *official* information and also relates to work done during the past twelve months. †Official figure, but seems extremely low.

Airport	Main runway: QFU, Length × Width (ft) and Surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
Nassau	09/27, 8,529×150, A	Unlimited	10	29 ART	*R/W extended by 1,429ft*
Natal, Brazil	16/34, 7,380×200, A	DC-7C max landing wt 109,000. t/o 142,900. Comet 4 t/o 140,000 and landing 114,793	160	29.4 est	
Ndola, Northern Rhodesia	10/28, 6,650×70, GL	LCN 35	4,160	26.5 ART	
New Orleans/Moisant	10/28, 7,400×150, C	120,000 single wheel 180,000 twin wheel 400,000 twin tandem	3	28.3 est	*R/W extended by 401ft*
New York International/Idlewild	13R/31L, 14,600×150, C	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	12	23.9 est	*R/W extended by 3,352ft*
New York/La Guardia	13/31, 5,914×200, A	80,000 single wheel 105,000 twin wheel 105,000 twin tandem	20	23.9 est	
New Jersey/Newark	04/22, 7,000×200, A	150,000 a.u.w.	18	23.9 est	
Niamey, Niger	09/27, 8,922×165, T	265,000 a.u.w.	732	36.9 ART	*R/W enlarged by 2,032ft. B/S raised from DC-6*
Nice/Cote d'Azur	04B/22B, 7,218×197, T	297,620 a.u.w.	13	24.5 ART	*R/W extended by 443ft*
Nicosia	14/32, 8,000×150, T	30,000 s.i.w.l.	728	27 ART	
Okinawa/Kadena	05L/23R, 12,100×300, C	Unlimited	142	28.4 est	
Ontario, California	07/25, 8,200×150, C	50,000 single wheel 65,000 twin wheel 125,000 twin tandem	952	N.A.	
Oslo/Fornebu	01/19, 5,750×164, A	99,210 s.i.w.l. at 121 lb/sq in	56	19.5 ART	Suggestion that Fornebu should serve as Norway's principal airport and that proposed new E/W R/W should be built as soon as possible
Ottawa/Uplands	14/32, 8,800×200, A	Super Constellation	374	22.5 est	
Palma/San Bonet	06/24, 4,921×147, A	28,660 s.i.w.l. at 85 lb/sq in	164	N.A.	
Palma/San San Juan	06/24, 7,874×196, A	59,520 s.i.w.l. at 100 lb/sq in	9	N.A.	*Originally military—now available for civil*
Panama/Tocumen	03/21, 8,800×200, C	All types of jet	135	34 est	*R/W extended by 1,800ft. B/S raised from C-124*
Paramaribo/Zandery, Surinam ...	10/28, 10,000×150, C	300,000 a.u.w.	80	25 est	
Paris/Le Bourget	07B/25B, 9,843×148, C	77,160 single wheel 88,180 twin wheel 154,320 bogie	217	22.1 ART	*New R/W. Shows increase in effective length of 1,100ft and raises B/S from 110,000 s.i.w.l.*
Paris/Orly	08I/26I, 10,893×197, C	99,210 s.i.w.l.	292	21.5 ART	*R/W length increased by 3,019ft*
Perth, Western Australia	06/24, 6,620×200, GL	LCN 24	51	25.4 ART	To be extended to 8,000ft and strengthened for jets
Philadelphia	09/27, 9,500×150, A	120,000 single wheel 200,000 twin wheel 400,000 twin tandem	14	23 est	Reported new R/W by 1960 of 11,000ft has not materialized
Pittsburgh/Greater Pittsburgh ...	10/28, 7,500×150, C	120,000 single wheel 200,000 twin wheel 400,000 twin tandem	1,168	21 est	
Portland, USA	10/28, 8,800×200, A	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	23	19 est	
Porto Alegre/Salgado Filho, Brazil	10/28, 6,560×137, C	Boeing 707—200,000 t/o and 175,000 landing. Caravelle t/o 96,000	9	24 est	
Porto Santo, Madeira	01/19, 5,248×148 ?	52,800 s.i.w.l.	305	N.A.	*Opened 28/8/60*—to be extended to 11,500ft
Poznan/Lawica, Poland	11/29, 7,050×164, C	156,000 a.u.w.	295	N.A.	
Prague/Ruzyne	04/22, 7,546×196, C-T 13/31, 7,610×148, C	30,070 s.i.w.l. 50,710 s.i.w.l.	1,246	18 ART	Shorter, weaker R/W is the instrument R/W. 1959 reports extending this to 8,595ft and building of new R/W initially 10,407ft and, later, 11,190ft not yet fulfilled. (Press reports)
Prestwick	13/31, 9,800×150, C	LCN 80	64	16 ART	*R/W extended by 2,300ft*
Quebec/Ancienne Lorette	06/24, 6,000×150, A	DC-6B	239	20 est	
Quito/Mariscal Sucre	16/34, 9,020×150, A	DC-6B	9,220	N.A.	
Rangoon/Mingaladon	03/21, 8,100×200, C	150,000 a.u.w.	109	29.9 est	Plans announced in 1958 to extend R/W to 10,200ft but no evidence of fulfilment yet
Recife	18/36, 7,800×200, A-C	DC-8. Comet 4, t/o 157,995 and landing 115,995	33	27.5 est	Plans announced in 1959 to strengthen R/W and extend it to 9,805ft
Riga	14/32, 5,577×164, C	N.A.	5	20.5 est	
Rio de Janeiro/Galeao	14/32, 10,324×200, C	Boeing 707, max t/o 286,000. No restrictions on other a/c	10	25.2 est	*R/W extended by 2,884ft and strengthened. In 1959 R/W was breaking up under jets and much work had to be done*
Rome/Ciampino	16/34, 7,218×197, T	59,520 s.i.w.l. at 114lb/sq in	423	22 ART	
Rome/Fiumicino	16/34, 12,795×196, C	99,210 s.i.w.l.	7	22 est	*At present available only to charter and technical flights previously authorized and to diversions arranged by Rome ACC when Ciampino is not available*
Riazan, USSR	06/24, 8,202×262, C	N.A.	393	23 est	*Alternate for Moscow*
Saigon/Tan Son Nhut	07/25, 6,560×132, T	88,000 a.u.w.	33	30.7 ART	Reported extension planned to 9,840ft

Abbreviations: R/W, runway; A, asphalt; C, concrete; Crl, coral; G, grass; GL, gravel; RS, rolled sand; T, tarmac; B/S, bearing strength; a.u.w., all-up (gross) weight; s.i.w.l., single isolated wheel load; LCN, load classification number; ART, airfield reference temperature (official figure—all other temperatures quoted are approximate "maximum mean" for hottest month of the year); est, estimated; NA, not available.

*Italic type in this column indicates *official* information and also relates to work done during the past twelve months.

Airport	Main runway: QFU, Length × Width (ft) and Surface	Bearing strength (lb)	Elev. (ft)	Temp. °C	Notes*
St Louis/Lambert	*12/30*, 10,018×200, C	160,000 single wheel 200 000 twin wheel 400 000 twin tandem	571	23 est	
Sal Island, Cap Verde	*02/20*, 6,560×164, A	99,210 s.i.w.l.	177	27.3 ART	
Salisbury	*06/24*, 8,612×150, C-GL	LCN 60	4,904	23.4 ART	
Salt Lake City	*16R/34L*, 8,300×150, A	120,000 single wheel 200,000 twin wheel 370,000 twin tandem	4,222	N.A.	
San Diego/Lindbergh	*09/27*, 8,100×200, C	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	15	22 est	
San Francisco	*10L/28R*, 9,500×200, A	200,000 single wheel 200,000 twin wheel 400,000 twin tandem	10	15 est	*R/W extended by 630ft*
San Jose, Costa Rica	*06/24*, 6,600×150, C	C-118	3,020	N.A.	
San Juan, Puerto Rico	*07/25*, 7,800×200, C	C-118	9	24 est	*Work in progress on R/W extension.* Reported in 1959 to be extended to 9,800ft
San Salvador, El Salvador	*08/26*, 5,250×150, A	C-54	2,044	N.A.	Planned for reconstruction
Santa Maria, Azores	*01/19*, 10,000×196, A-C	77,160 s.i.w.l.	305	23.1 ART	
Santiago/Los Cerrillos	*03/21*, 6,575×150, C	Boeing 707	1,675	21.4 est	*B/S raised from C-124*
Sao Paulo/Congonhas	*16R/34L*, 6,190×160, C	Britannia 308, with landing & take-off wt restrictions	2,627	23.3 est	To continue in use for anything less than the bigger jet aircraft
Sao Paulo/Viracopos	*14/32*, 10,630×148, C	Boeing 707, DC-8	2,099	N.A.	*Opened October 1960—60 mls from Sao Paulo*
Seattle/Tacoma	*16/34*, 10,200×150, C	120,000 single wheel 180,000 twin wheel 400 000 twin tandem	428	18 est	
Shannon	*05/23*, 7,024×200, C	51,000 s.i.w.l.	47	15.8 est	Reported new R/W to be 10,000ft × 200ft (in 1959)
Singapore	*02/20*, 8,200×200, C	60,000 s.i.w.l. at 100 lb/sq in	59	27.7 est	*R/W extended by 200ft.* Reported in 1959 that extension to 10,000ft was planned
Southend	*06/24*, 5,265×120, T	LCN unknown	48	19 ART	
Stavanger/Sola	*18/36*, 8,366×246, C	99,210 s.i.w.l.	28	15.6 ART	
Stephenville	*10/28*, 10,000×200, A	B-377	86	N.A.	
Stockholm/Arlanda	*01/19*, 10,826×147, C	132,280 s.i.w.l.	111	19 ART	*New airfield*
Stockholm/Bromma	*13/31*, 6,223×196, A	33,069 s.i.w.l.	45	19 ART	
Stuttgart	*08/26*, 5,900×164, C	59,500 s.i.w.l.	1,296	20.1 ART	
Sydney/Kingsford Smith	*06/24*, 8,290×200, C	LCN 100	10	23.3 ART	*R/W extended by 400ft.* Extension plan to 10,000ft reported
Sydney, Nova Scotia	*07/25*, 7,070×200, A	200,000 a.u.w.	202	22.9 est	
Tahiti	*04/22*, 6,232×147, T	330,000 a.u.w.	6	N.A.	*New airfield. To be extended to 10,988ft*
Taipei	*10/28*, 7,544×200, C	90,000 s.i.w.l.	19	30.1 ART	
Tamanrasset/Aguennar	*03/21*, 7,218×197, RS	N.A.	4,495	N.A.	
Tampa, Florida	*18/36*, 8,300×150, A	80,000 single wheel 120,000 twin wheel 270,000 twin tandem	27	23 est	*R/W extended by 1,302ft*
Tangier	*08/26*, 5,741×147, A	132,280 a.u.w.	46	24 est	
Tegucigalpa, Honduras	*N/S*, 5,900×150, A	DC-6	3,270	N.A.	
Teheran/Mehrabad	*11/29*, 9,840×196, C	169,000 a.u.w.	3,937	31.8 ART	Five-year plan being studied for extending R/W to 13,200ft × 200ft—295,000 a.u.w.
Tel Aviv/Lod	*11/29*, 7,741×150, T	66,140 s.i.w.l.	132	25 ART	*New R/W of 10,000ft×150ft nearing completion*
Titograd/Golubvci	*002/182*, 8,202×150, C	22,050 s.i.w.l.	101	N.A.	
Tokio	*15/33*, 8,400×148, A-C	51,000 s.i.w.l.	7	28.1 ART	Reported new R/W to be built—11,000ft
Toronto/Malton	*14/32*, 11,050×200, A-C	Super Constellation	565	20 est	New R/W planned parallel to present *14/32*—length 10,000ft
Toulouse/Blagnac	*15/33*, 8,202×197, C	220,500 a.u.w.	499	29.1 ART	
Trinidad/Piarco	*10/28*, 7,810×150, A	300,000 a.u.w.	45	27 ART	*Work in progress for 6 months' strengthening, resurfacing and recambering.* Reported planned for extension by 1,700ft
Turin/Caselle	*001/181*, 9,842×197, C	77,160 s.i.w.l.	986	17 ART	*R/W lengthened by 1,476ft*
Tunis/El Aouina	*11/29*, 6,003×151, T	39,680 s.i.w.l.	16	29 ART	
Turku, Finland	*08/26*, 5,905×197, A	154,320 a.u.w.	160	19 ART	
Valencia	*12/30*, 7,788×197, A	51,810 s.i.w.l. at 100 lb/sq in	196	N.A.	
Vancouver	*08/26*, 8,600×200, C	75,000 s.i.w.l.	9	18 est	
Velikie Luki, USSR	*15/33*, 3,937×295, T	N.A.	328	N.A.	
Vienna/Schwechat	*12/30*, 9,842×197, C	38,500 s.i.w.l.	600	21.8 ART	*R/W has been extended by 3,281ft*
Vilnius, USSR	*17/35*, 3,937×197, C	N.A.	623	N.A.	*New R/W 02/20 reported 1959*
Wadi Halfa, Sudan	*18/36*, 6,000×150, GL	90,000 a.u.w.	509	33.3 est	
Wake	*09/27*, 9,500×150, C	200,000 twin wheel	14	28 est	
Warsaw/Okecie	*15/33*, 6,561×197, C	165,345 a.u.w.	345	17 est	Reported R/Ws to be extended and new terminal building to be erected 1961-1965
Washington, DC	*18/36*, 6,870×200, A	120,000 single wheel 200,000 twin wheel 400,000 twin tandem	15	25.4 est	*R/W extended by 130ft*
Washington/Dulles International	*18/36*, 11,500×150, C	N.A.	N.A.	N.A.	New airport, opening in mid-1961
Winnipeg	*13/31*, 8,700×200, A	Super Constellation	785	21.7 est	
Zagreb/Pleso, Yugoslavia	*05/23*, 8,200×147, C	44,090 s.i.w.l.	351	20 est	New concrete R/W under construction.
Zaragosa, Spain	*13/31*, 12,140×196, C	77,845 s.i.w.l. at 185lb/sq in	833	N.A.	
Zurich/Zurich	*16/34*, 8,530×196, C	148,800 s.i.w.l.	1,414	18.5 est	Work reported in progress extending R/W to 12,700ft has not materialized

Abbreviations: R/W, runway; A, asphalt; C, concrete; Crl, coral; G, grass; GL, gravel; RS, rolled sand; T, tarmac; B/S, bearing strength; a.u.w, all-up (gross) weight; s.i.w.l., single isolated wheel load; LCN, load classification number; ART, airfield reference temperature (official figure—all other temperatures quoted are approximate "maximum mean" for hottest month of the year); est, estimated; NA, not available.

*Italic type in this column indicates *official* information and also relates to work done during the past twelve months.

These "Flight" photographs by [illegible] were tak
at London Airport North (below [illegible]tral (righ
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of Air-India 707 Conway pow[illegible]OAC Com
BEA embarkation scene at LAP[illegible] North-side

FROM NORTH, SOUTH, EAST AND WEST TO NO[illegible]AND

hs by [illegible] were taken last week [illegible]ntral (right). This time [illegible] process of transferring [illegible]ase in the central area. [illegible]mmer.) At left, a pair [illegible]OAC Comet 4. Right, [illegible] North-side apron scene

ND CENTRAL: LONDON AIRPORT 1960

THE EXPANDING GIRDLE (continued from page 906)

The remainder are gleaned from press reports. Two points emerge. The bulk of the improvements reported in the press have failed to materialize. Secondly, a sizeable number of officially notified improvements have either only just started or are still in abeyance. Procrastination may be the thief of time but he is an old friend of many a Treasury official.

Among the items of work at present in hand, London Airport is of particular interest. It may be recalled that at this time last year one of the two parallel main runways (10L/28R) was closed for about six months in order that extensive work on lighting and resurfacing could be carried out. This year the other runway (10R/28L) will be out of service for a similar period. But 10L/28R, which had so much work done on it six months ago, is now being closed most nights from 2300hr to 0600hr, which seems to suggest deterioration of its general condition. In view of the disintegration of other runways under the impact of large jets one cannot help feeling a certain apprehension for London.

As fast as the fleets of big jets grow so do the activities of those who are opposed to the fiendish noise they make. The problem can be measured by the operating restrictions which are being introduced: Manila International will not allow any Boeing 707 or DC-8 to land by night; Denmark, Western Germany and Sweden have all imposed restrictions, as have Los Angeles and New York. London also imposed some but these seem to be unobtrusively slackening.

In the vicinity of some airports, monitoring stations have been set up on the ground to measure jet noise. Some airlines, or certainly some captains, have got the better of this scheme by a very simple procedure. Knowing the exact location of the ground stations they approach them at full throttle, reduce power as they pass overhead, and then open up again.

The Port of New York Authority has been a pioneer in its attempts to curtail noise. Alleging that Delta Airlines had frequently violated anti-noise regulations, the PNYA instituted court proceedings against the airline on October 26 last. Originally the company had until November 17 to answer the case, but one now hears that six weeks' extension until December 31 has been granted. The airline has already stated that, given extra time, it can show that it is both willing and able to comply with the rules. In this case it is probable that the court action will be dropped. If so it means that the immediate chance of deciding the legality or otherwise of the PNYA's rules will be postponed. One body of opinion claims that the rules have no legality. They argue that they curtail air traffic, constitute an excessive burden on commercial air activities and that, ultimately, the control of air traffic is vested in the FAA. But as the landlord drawing up the contracts by which various airlines use the New York aerodromes it is entitled to expect users to comply with the conditions and rules of the contract. If more were needed it could plead that it must make rules of this kind in sheer self defence against local inhabitants charging it with not actively trying to suppress the nuisance of noise.

In last year's special airports number of *Flight* it was said that the total amount of extra concrete required for planned extensions of the world's runways was equivalent to an 80ft wide road running a distance of 346 miles from London to Berwick-on-Tweed. Work in 1959 produced 21 miles of this, but at the end of 1960 a little over 70 miles is seen to have been built. This means that we are now about seven or eight miles past Market Harborough.

Very few airports made a profit last year, and since then millions of pounds have been spent on improvements and more is in the pipeline. If the airlines imagine that this is pure altruism then they are living in a fool's paradise. The money will have to be found from somewhere and already there are clear indications of the sources from which governments expect to get some of it. Australia increased charges by about 60 per cent in October, warning that this was to be the first of an annual series of "reviews of charges," with the ultimate intention of making the airlines absorb the cost of *all* improvements which could properly be attributed to it. The UK has already announced the intention of raising landing fees by an average of one-third early next year. The airlines had better start drafting their protests right away because some other countries will feel impelled to follow suit.

DESIGN FOR DEPARTURE: A MODERN CITY TERMINAL

During 1960 about £1 million has been spent by BOAC on the improvement and restyling of their London air terminal at Victoria. This view shows the main concourse, where passengers check in before boarding coaches for London Airport. British European Airways also have a town terminal, situated in the Cromwell Road: at present a temporary building over the railway, it is to be developed into a permanent terminal at a cost, which includes also a new BEA reservations centre and other offices, of about £3 million

"Flight" photograph

ON this and succeeding pages are details of the majority of the airport services and equipment at present available from United Kingdom manufacturers. Also given—in the lists below—are the names and addresses of architects who have designed airports, of aerodrome construction companies and of manufacturers of hangars and buildings. A complete list of addresses of the other companies to which reference is made appears on pages 926-927.

"Flight" photograph

AIRPORT INSTALLATIONS AND EQUIPMENT

A "Flight" Guide to Representative British Services and Products

AIRPORTS AND GROUND EQUIPMENT

AIRPORT ARCHITECTS

Consulting architects who have designed airfields in the British Isles include:—

Chitty, A. M., 30 Percy Street, London, W1.
Fitzgerald, John D., 140 Grace Park Road, Drumcondra, Dublin.
Gibberd, Fdk., 8 Percy Street, London, W1.
Kinnimonth, W. H., 46a Dick Place, Edinburgh.
MacDonald, Alister & Partners, Aldine House, 10-13 Bedford Street, London, WC2.
Mason, H. C., 14 The Avenue, Cheam, Surrey.
Matthew & Johnson-Marshall, Robert, 31 Regent Terrace, Edinburgh 7.
Meredith, J. Nelson, The Council House, Bristol 1.
Morgan, Guy & Partners, 12a Eaton Square, London, SW1.
Norman & Dawbarn, 7 Portland Place, London, W1.
Pascall & Peter Watson, Clive, 24 Half Moon Street, London, W1.
Ross, Eric, 11 Cranleigh Gardens, Stoke Bishop, Bristol.
Russell, R. T., "Millhays," Bickleigh Bridge, near Tiverton, Devon.
Smith, Stanley H., 76 Priory Ave, London, E4.
Wilson, J. M., of J. M. Wilson, H. C. Mason and Partners, 3 Chandos Street, London, W1.
Yorke, Rosenberg & Mardall, 2 Hyde Park Place, London, W1.

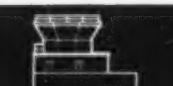
BUILDING & RUNWAY CONTRACTORS

Amey's Asphalt Co Ltd, Sutton Courtenay, Abingdon, Berks. T: Sutton Courtenay 260.
Bellman Hangars Ltd, Hobart House, Grosvenor Place, London, SW1. T: Sloane 5259.
British Insulated Callender's Construction Co Ltd, 30 Leicester Square, London, WC2. T: Trafalgar 7777.
Constable Hart & Co Ltd, North Circular Road, London, NW2. T: Gladstone 2287.
Costain Ltd, Richard, 111 Westminster Bridge Road, London, SE1. T: Waterloo 4977.
En-Tout-Cas Co Ltd, The, Syston, near Leicester: T: Syston 3322.
Gee Walker & Slater Ltd, 100 Park Lane, London, W1. T: Mayfair 7484.
Laing & Son Ltd, John, Page Street, London, NW7. T: Mill Hill 3636.
McAlpine & Sons Ltd, Sir Robert, 80 Park Lane, London, W1. T: Mayfair 8234.
Trentham Ltd, G. Percy, Pangbourne, Reading, Berks. T: Pangbourne 411.
Wimpey & Co Ltd, George, Hammersmith Grove, London, W6. T: Riverside 2000.

Resurfacing the new 5,300ft runway at Baginton, Coventry, with Amey's asphalt (main contractors, G. Percy Trentham Ltd)

PART ONE

FIXED INSTALLATIONS



G.E.C. Type ZA.707 visual glide-path indicator unit, using standard 200W Osram lamps

Harley mobile floodlight

Lighting

The General Electric Co Ltd supply almost every type of airport lighting equipment, including complete systems. New types include the ZA.707 visual glide-path indicator unit; the ZA.109 and ZA.109B high-intensity flush runway lights for use in the touchdown area of a runway and as centre-line lights; the ZA.755 quadruple obstruction light; and the ZA.801 taxiway flasher unit, which needs no special power supply or extra cables, being plugged in between the existing isolating transformer and light to be flashed.

An advantage of the new VGPI is that it uses four standard 200W Osram lamps. Design emphasis is on serviceability and the equipment is housed in a glass-fibre casing. Four ZA.707s have recently been installed on runway 24 at Southend Airport and are now undergoing trials.

A widely used G.E.C. fitting is the ZA.105 high-intensity elevated runway light which, following introduction at Southend, has been adopted at Hurn, Prestwick, Renfrew, Jersey, Guernsey, Luton, Leeds/Bradford, and Coventry.

During the year the company has completed lighting installations at Guernsey, Luton, Leeds/Bradford, Coventry, Wellington (NZ) and Nandi (Fiji)), and at the Westland Heliport at Battersea. Current contracts include Plaisance, Mauritius; Karachi, Pakistan; Belgrade and Zagreb, Yugoslavia; Coolidge, Antigua; and lighting for a helicopter landing stage which will be part of a deep-water tanker terminal at Khor-Al-Amaya in the Persian Gulf.

The visual glide-path indicator system developed by the Blind Landing Experimental Unit is manufactured by **Thorn Electrical Industries Ltd.** Other manufacturers of high-intensity approach lights include **The Benjamin Electric Ltd, Engineering & Lighting Equipment Co Ltd, Holophane Ltd,** and **Revo Electric Co Ltd.** Airfield marker and taxiway lights are manufactured by **Butlers Ltd.** Airport location and other visual beacons are made by **Stone-Chance Ltd,** who also manufacture stand-by electrical equipment.

Harley Aircraft Landing Lamps manufacture a wide range of mobile lighting equipment, mainly of the self-generating type but also available with transformers for mains operation. There are small box-type units that can be easily manhandled and carried in small vehicles; self-propelled units capable of being positioned under their own motive power; and trailer-type units for fast towing behind airfield vehicles.

Though perhaps best known in aviation for their radio equipment, **Standard Telephones and Cables Ltd** also make control equipment for airport electrical systems, and in this field their Rectifier Division is responsible for a comprehensive range of high-voltage d.c. cable-test equipment under the trade-name "SenTerCet." Of particular interest, too, is this division's cathodic protection system, designed to guard buried or submerged metal structures against corrosion.

Though better known in the aircraft field for airborne wiring and switchgear, **C.W.C. Equipment Ltd** also make a variety of detail electrical items which find application in airport lighting systems and buildings.

British Insulated Callender's Cables Ltd need no introduction as manufacturers of almost every conceivable type of electrical cable, and their products are used in airport installations all over the world, not only for lighting and power but for radio, radar and numerous other applications in the communications field.

Among specialists in airport lighting are **C. Maurice Contractors Ltd,** who have been responsible for a number of major installations of G.E.C. equipment.

Buildings and Runways

Building and runway-construction contractors are listed on the previous page. Additionally, it may be mentioned that easily erected temporary shelters of various sizes are made by **P. Frankenstein & Sons (Manchester) Ltd,** based on a "balloon" principle in which the shape of the fabric shelter is maintained by a low-pressure air fan.

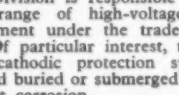
Runway Marking

Fully approved by the MoA, Epigloss line-marking paint is made by **Coates Bros Paints Ltd** and has been used on a number of airfields—including Gatwick, where, it is stated, lines marked over three years ago are still in excellent condition. A subsidiary compound is Marathon cleaning solution for removing tyre marks from painted lines, and the same firm have also developed a joint-sealing compound which is highly resistant to jet blast.

Other manufacturers of special materials for runway marking include **Docker Brothers** and the **Witco Chemical Co Ltd.**

PART TWO

RADAR, RADIO AND METEOROLOGY



Back-to-back aerial system of the Decca 10cm DASR.1 surveillance radar

Marconi S264 surveillance radar in 50cm band, with turning gear and electronics in sunken building. This unit is at Jersey

Surveillance Radar

The latest in the series of general-purpose surveillance radars manufactured by **Cossor Radar & Electronics Ltd** is the S-band (10cm) Type C.R.787. Cossor claim that the 10cm band gives good vertical coverage without gaps, narrow beam-width with resultant high-definition display, and a reasonable aerial size and power consumption. Circular polarization can be introduced at will to eliminate rain echoes. The C.R.787 can be supplied in a trailer, suitable for movement on second-class roads, accommodating a machine cabin, aerial assembly and a well-lit, ventilated cabin housing one or two transmitter-receivers and display units. Alternatively, the weatherproof cabin and the aerial can be mounted on a tower or on the roof of a building. C.R.787 equipment is in service in Australia, New Zealand, Africa and Europe.

Mobile and static versions of the shorter-range C.R.21 S-band surveillance radar are also available. Both the C.R.787 and C.R.21 may be combined with secondary radar.

Cossor have done pioneering work in the development of secondary radar for civil air traffic and a mobile version of the S.S.R.4G ground equipment is now being evaluated at London Airport. It includes sidelobe suppression, signals being transmitted and received at a 30ft beam aerial the rotation of which is slaved to that of the surveillance radar with which it is working. Range is a function of the transponder triggering sensitivity as well as of transmitted powers, but with standard transponders the range of the S.S.R.4G is 180 n.m. for aircraft flying at 30,000ft. Transmitter nominal frequency is 1,030Mc/s. Cossor are developing transponder equipment to conform with all the ICAO and Arinc characteristics.

Cossor are further developing the CRD.23 advanced radar display systems, designed on the "building-block" principle. Information from CRDF and secondary radar is accepted and map displays from a twin video-mapping unit may be superimposed by interscan marking. Other features include four switched range-scales, up to ten aircraft identification

and tracking symbols and facilities for target handover to parallel viewing units.

Decca Radar Ltd offer the Type D.A.S.R.1 S-band primary surveillance equipment, giving gap-free coverage to ranges of over 100 n.m. and heights above 40,000ft. It features a back-to-back (cosec² and linear) aerial system, variable circular polarization to eliminate precipitation returns, and a form of permanent echo suppression known as Air Target Indication. Interscan displays permit superimposition of tracking and map information.

More than 100 orders have now been received for the Decca airfield control radar Type 424, a low-cost static, air-transportable or mobile landing aid which provides all-round surveillance for aircraft in the local area as well as precision azimuth information for final talk-down. Variable polarization reduces precipitation echoes. The fully controllable display incorporates range markers, bearing cursor and off-centre controls. Transmission is at 9,320-9,500Mc/s and max power is 30kW.

Decca also manufacture ASMI (airfield surface movement indicator) radar for controlling and observing movement on the ground in poor visibility. Range is eight miles, transmitting in Q-band at 15kW.

Marconi's Wireless Telegraph Co Ltd offer a wide range of high-performance radars in the 10, 25 and 50cm bands, each with its own advantages. In the 10cm (S-band) category, the Type S.306 offers good discrimination between close targets, freedom from siting difficulties, and unattended operation, with full remote control. A triple-pulse MTI permanent echo-cancellation system is fitted. The very high peak-power of 3MW is a feature of this equipment, which operates on frequencies between 2,700 and 3,300Mc/s.

For airports where the aerial must be mounted on the control tower, the Type S.263/1 is available in the 10cm range, with lightweight aerial capable of operation in wind speeds up to 70 m.p.h. Peak power is over 800kW; frequency 2,960-3,040Mc/s.

One of the latest Marconi long-range surveillance radars is the Type S.247, comprising two high-power (2½-3MW) transmitters, one at 10cm and one at 25cm, feeding a combined back-to-back aerial system. Together they give continuous cover on targets up to 75,000ft, with provision for MTI, remote control, etc.

Type S.255 utilizes the 25cm (L-band) system only, to give cover on small aircraft out to 200 miles. It is less affected by cloud and rain clutter than 10cm equipment, offers more efficient MTI characteristics and is capable of considerably better overall performance. Peak power is 2.5MW.

Marconi's 50cm radar sets combine all the features of the 10 and 25cm types, with outstanding reliability and freedom from the effects of weather and permanent echoes. The Type S.264A is a 500kW system developed from the equipment which has been used for some years at London Airport. The S.264A/H has a modified aerial providing increased vertical coverage at the expense of maximum range. Most recent of the series is the S.307, which possesses all the qualities of the S.264A but has improved definition and increased maximum range. All these radars are crystal-controlled and can be used simultaneously on long-range surveillance or close control of aircraft within the terminal area, using either fixed-coil or moving-coil PPI displays and video mapping if required. Display units developed for use with these installations offer the latest facilities for target marking, tracking and handover between consoles.

Other Marconi radar sets range from the Type S.261 mobile 50cm radar to the 3cm SNW.40 series, which have a range of up to 45 n.m., with a peak power of 40-50kW and frequency of 9,360-9,460Mc/s.

A recent Marconi development is a parametric amplifier for use with the range of 50cm radars. It incorporates a fully coherent pump frequency which is crystal-locked to the radar and to a fully coherent MTI—the only one of its type in the world. The tube itself and its solenoid are manufactured by the **English Electric Valve Co.**

Aerial mountings and turning gear for surveillance radar are among the products of **John Curran Ltd.**

Height-finding Radar

From **Marconi** comes the Type S.239 800kW 10cm height-finder, designed to operate in conjunction with long-range surveillance radars and with an accuracy of ± 500ft at 50 n.m. Its parabolic reflector aerial "nods" to cover a vertical angle between −1° and +25° ten times per minute, and transmits on a fixed frequency in the 2,960-3,040Mc/s band. It is controlled from the elevation/scan display console.

The Type S.244 is more powerful, with an accuracy of ± 1,700ft at 150 n.m. It has a peak output of 3MW in the 2,700-2,900Mc/s band and is capable of determining the absolute height of an aircraft above the ground or the relative heights of two aircraft. It can also operate as a volumetric radar, providing both height and plan position information.

Another highly-accurate long-range height-finder is the **Decca** HF.200. Like the Marconi S.244, this incorporates automatic limitation of the angle of nod when dealing with long-range targets, to avoid scanning useless airspace at high angles of elevation.

Precision Approach Systems

Probably the most important guidance element in precision approach is ILS; and its importance is likely to increase as automatic landing systems are introduced. Already in service for some time is the ILS manufactured by **Pye Telecommunications Ltd** and in world-wide service as a civil and military approach aid. It utilizes a uni-directional localizer and has full monitoring, self-correction and stand-by equipment in accordance with ICAO specifications. Marker beacons are usually positioned some five miles and 3,500ft from the threshold and at the threshold itself.

A more recent installation is the STAN 7/8/9 ILS with localizer, glide-slope and marker beacon transmitters, now being produced by **Standard Telephones & Cables Ltd** for the MoA. It includes directional and clearance localizer aerials, which reduce siting problems. Many components, including the fail-safe monitors, are transistorized and a newly developed mechanical modulation system gives greater stability and freedom from phase distortion. Both localizer and glide-path transmitters are fully monitored and automatic five-second change-over are provided between main and standby transmitters. Standard Telephones' ILS has been installed at London Airport and is on order for several other major airports in Britain and abroad.

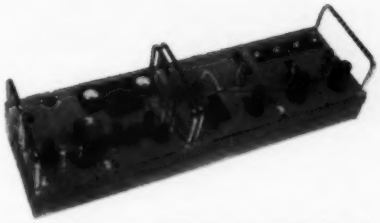
A system which may possibly be used in conjunction with ILS for automatic landing is the Leader Cable, for which the airborne and ground-based units have been produced by **Murphy Radio Ltd.** The cables are laid parallel with the runway centreline extended some 5,000ft beyond the end of the runway. Leader Cable at present forms part of the military Autoland system.

Simplest of the precision approach radars and already proven in service at Southend Airport is the **Ekco Electronics Ltd** Type CE71 approach aid, which combines a manually-aimed 3cm ranging radar with a VHF DF system. Suitable for either static or mobile installation, it can be operated by one man and provides talkdown facilities for every type of aircraft. Operating from a.c. mains, the equipment has a power output of 10kW. The A-scope display is calibrated in two ranges, 0-4 and 0-16 n.m., and an azimuth cursor can be used for directing off-set final approaches.

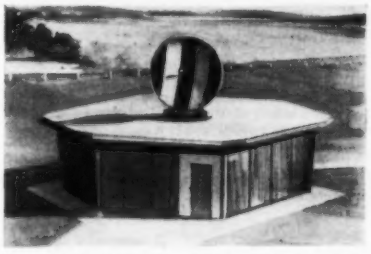
Precision Approach Radar SLA.3/B2, manufactured by **Standard Telephones & Cables Ltd,** provides the controller with three-dimensional information on approaching aircraft on twin azimuth/range and elevation/range cathode-ray tubes. Two 50kW 3cm transmitters, installed in an unattended vehicle, radiate a pulsed fan beam which sweeps an area of approximately three miles by one mile at a range of ten miles. After an aircraft has been directed into this area, it can be talked down by GCA procedure. Installations can be fixed or turntable-mounted to cover several runways. Airports at which SLA.3/B2 radar is in use include Hong Kong and Wellington, New Zealand, where the runways extend out to sea and are approached over difficult terrain.

Direction-finding and Beacon Equipment

Ekco Electronics Ltd offer at an exceptionally low price (approximately £2,000) the CE.178 CRDF equipment with a range of about 100 miles for an aircraft flying at 10,000ft, and radiating 5W. Bearing indication



Pump frequency multiplier and amplifier of the Marconi parametric amplifier for surveillance radars



Cossor CR.353 meteorological radar (artist's impression)

is given, with a maximum error of ±1.5 deg, by a single radial line on a 6in cathode-ray tube, which can be positioned up to 2 n.m. from the 250 r.p.m. Adcock aerial. Frequency range is 100-156Mc/s.

Marconi produce a range of DF equipment. Types AD.210A and B provide visual, automatically sensed bearing indication on four channels simultaneously. They operate in the 100-156Mc/s band and can be integrated with ground-to-air communications schemes to provide combined DF and voice facilities. In addition, airfield control radar of suitable type can be fed with DF intelligence for identification purposes. Five crystal-controlled frequencies are provided for each channel. Type AD.210C is a simple low-cost single-channel model. In all cases the master and slave display units can be sited remotely.

Type AD.200 is a two-channel equipment operating in the 118-132Mc/s band, with local or remote (up to 30 miles) instantaneous presentation on an 8in diameter meter indicator. It is suitable for fixer or homer stations and will provide VHF DF identification for airfield control radar. An automatic fixer equipment is available for use with the AD.200 and AD.210 series, giving direct presentation of an aircraft fix on a 17in cathode-ray tube, with a superimposed translucent map of the control area and controllable offset bearing-and-distance trace.

Marconi also produce the Type DFg26/4 HF DF equipment with twin channels and frequency range of 1.5-21Mc/s in four bands. Bearing presentation can be by spinning goniometer or cathode-ray oscilloscope. The Type DFg29 is a manually operated HF DF installation which can be mobile for rapid positioning and can operate where earth conductivity is so poor as to degrade the performance of an Adcock aerial.

Instantaneous automatic direction finding at all aircraft frequencies is provided by **Standard Telephones & Cables** PQ range, which employ the latest commutated antenna techniques. CADF gives from five to ten times greater freedom from errors than does conventional DF. By electronic time-sharing, simultaneous presentation of DF bearings from two separate channels or equipment can be displayed on one Type A2208 cathode-ray indicator. For automatic position-fixing a number of DF stations can be linked to a control room where individual bearing lines are optically projected on a large map screen. A more recent development is the PVT.2, in which the bearings are optically projected from miniature CRDF displays and combined with map transparencies for presentation on a closed-circuit television system.

VOR ground beacons of Type BO.2 are also being produced by Standard Telephones and

Cables. They meet ICAO standards. An important feature is the radically reduced cone of confusion achieved by the use of a wide-aperture aerial system. S.T.C. are also responsible for the STURN.3 and STURN.4 Tacan beacons and the STURN.5 DMET beacon, the last-named for use in conjunction with VOR. The STURN.5 incorporates self-monitoring and automatic change-over and has a range of 300 n.m. with 126 operating channels. Eleven VOR beacons produced by **Marconi** have been delivered for installation on United Kingdom airways.

DME equipment available from **Murphy Radio Ltd** includes the Type RB110 transponder beacon, which transmits at between 200Mc/s and 235Mc/s and can serve 75 aircraft simultaneously. It can be controlled remotely and automatic supervision can be provided by beacon control equipment MR255. Babs Mk 4 is a beacon for use with Rebecca Mk 8 airborne equipment as a DME approach aid. MR347 is a mobile beacon for use with Rebecca.

Non-directional Beacons

Non-directional MF beacons for locator, homing and airways use available from **Marconi** include the Types WB8, AD501 and AD511 of 2.5-3.3kW, 250W and 20W power respectively. These have provision for CW, MCW and code-sending devices, and may be duplicated and fault monitored with automatic switchover.

Redifon Ltd manufacture a range of beacons which transmit at between 20W and 2.5kW on frequencies of 137-550kc/s, with CW/MCW. Some types incorporate RT facilities. Other manufacturers of non-directional beacons include **General Electric** and **Standard Telephones & Cables.**

Weather and Wind-finding Radar

Marconi's Type SNW51 radar detects storms and rain-producing clouds over ranges up to 200 n.m., using a static or mobile aerial. Peak power output is about 40kW, operating in the X-band (9,360-9,460Mc/s), with presentation on a moving-coil P.P.I.

Comparable equipment from **Decca Radar Ltd,** in world-wide use at airports, is weather radar Type 41 Mk IIA, a 25kW radar with a range of up to 220 n.m., in the X-band.

Wind velocities at heights up to 130,000ft and ranges up to 125 miles are given by **Cossor's** Type CR.353 10cm radar which works on the same principle. In its basic form it provides a display of range, bearing and elevation, but additional units can be supplied, such as PPI display, data recorder, teleprinter relay transmitter and a height and range resolver. The aerial can operate in winds of up to 100kt. Eight CR.353s have been ordered for use in New Zealand and the southern Pacific Ocean.

Another windfinding radar from Decca is the type WF 1, used by some 20 meteorological authorities for obtaining regular wind data at heights of up to 10,000ft. Simple to operate, it employs a form of conical scan to track a passive reflector carried by an expendable balloon. Winds at all levels are calculated from successive readings of range, azimuth and elevation.

Meteorological Equipment

Short & Mason Ltd manufacture a range of apparatus among which are wind direction and speed indicators and a special aneroid barometer for airport control towers. The barometer is extremely sensitive to small pressure changes, is fully compensated for temperature and is mounted in a case, to match the remote-reading dials of the two electrical wind instruments.

R. W. Munro Ltd make various types of electrical wind speed and direction recording instruments, including types in which the cup-type anemometer is mounter directly above the direction vane, on the same mast. Portable instruments, for recording wind data in the vicinity of buildings, etc., are also manufactured.

A very full range of meteorological instruments is available from the old-established firm of **Negretti & Zambra Ltd.**

The simple wind-sock still has its uses, and the **R.F.D. Co Ltd** are makers.

An unusually interesting item of meteorological equipment is the cloudbase recorder (described in *Flight* for August 26 last). **Airtech Ltd** have recently completed the first production models based on a prototype developed and made by the Meteorological Office and currently undergoing operational trials. The system records continuously on a chart the height of the cloudbase, as derived by triangulation from a scanning transmitter using a modulated light beam. Reflection from the cloud is detected by a receiver unit 350ft from the transmitter, the angle of the light projector being sensed and fed with the received signal into the recorder. The height of the cloud, calculated by triangulation, is then displayed on a strip chart recorder remotely located in the control tower. Cloudbases up to 4,000ft can be recorded. The three units are linked by land lines.

Cossor type 184 VHF transmitter/receiver for 100-156Mc/s band

VHF Ground/Air Communications

A very wide range of VHF ground-to-air transmitters and receivers is offered by British manufacturers, including **British Communications Corporation, Ekco Electronics Ltd, Elliott Brothers (London) Ltd, General Electric Co Ltd, Marconi's Wireless Telegraph Co Ltd, Murphy Radio Ltd, Plessey Co Ltd, Pye Telecommunications Ltd, Redifon Ltd,** and **Stratton & Co Ltd.**

Among recent products is **Standard Telephones'** Type DU.5, a 50W crystal-controlled AM transmitter which operates in the band 100-118 and 117-156 Mc/s and employs only eight valves. Its associated receiver, the single-channel crystal-locked RX.20, has selectivity for 50kc/s channel-spacing and can feed a remote operator's position via telephone lines.

Equipment for the new Pan American ground-to-air VHF radio station at Ballybunion, Eire, probably the most powerful in use by any airline, was supplied by Telecommunications Ltd of Dublin, an associate of **Pye Ltd.** With an effective radiated power of nearly 100kW, the equipment makes possible two-way voice communication with aircraft over the Atlantic at ranges up to 500 miles.

Many of these manufacturers provide a wide variety of mobile VHF communications radios for use on ground vehicles and in man-carried packs not necessarily for airfield use alone. **W.S. Electronics Ltd** are offering an airfield communications system based on a 90kc/s transmitter exciting loops surrounding the areas in which communications are required, the receiver being a hand-held 90kc/s unit containing a UHF transmitter for direct reply to the control centre. Individual calling by tuned-reed selector system is possible and an automatic battery charger is provided for recharging batteries of the hand-held units. Known as the D.126 communications system, this equipment is being supplied to the RAF, but is offered for civil use as well.

HF Communications

HF radio equipment for airport use is obtainable from **Airmec Ltd, General Electric Co Ltd, Marconi's Wireless Telegraph Co Ltd, Mullard Ltd, The Plessey Co Ltd, Pye Ltd, Racal Engineering Ltd, Redifon Ltd,** and **Standard Telephones & Cables Ltd.**

Message Recording and Transmission

Several companies manufacture equipment for continuous recording of RT traffic on tape. The **British Communications Corp** system may be one-, two- or three-bay, with each bay recording autotmatically up to 20 channels for eight hours and with self-monitoring.

The systems produced by **Simon Equipment Ltd** and **Thermionic Products Ltd** are self-monitoring, with automatic change-over from one tape to another. The Simon LDT 14 is based on four-channel six-hour units, with optional TIU-3 time-injector to superimpose timing signals directly on to the tape. The latest recorder from Thermionic Products is the Series III, based on a number of "building blocks" and incorporating transistors and printed circuitry. The first units is now being installed in the Isle of Man, several foreign air forces have ordered it and it has also been ordered by electricity generating authorities, cable and wireless companies, fire stations and other organizations.

Creed & Co Ltd manufacture the Seventy-five teleprinter in which the typehead is movable instead of the paper unit. They have produced a machine weighing only 40lb and considerably smaller than any other printer, yet offering speeds up to 100 words per min, a 50 per cent increase over previous speeds. Many

Left, hand-held receiver of W.S. Electronics type D.126 airfield communications system

Right, Pye telecommunications high-power VHF transmitter aerials set up in Ireland for PanAm. Range about 500 miles

Far right, projector of the Meteorological Office cloudbase recorder made by Airtech Ltd

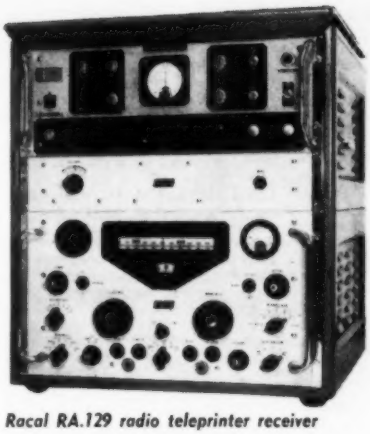
additional models are available from Creed, from **Standard Telephones & Cables**, with whom they are associated, and from **The Plessey Co.**

Racal Engineering offer a radio teleprinter HF receiver terminal in two forms, the RA.103 and RA.129. The units are suitable for f.s.k. working and can be extended from the 1-30Mc/s band to 12.5kc/s.

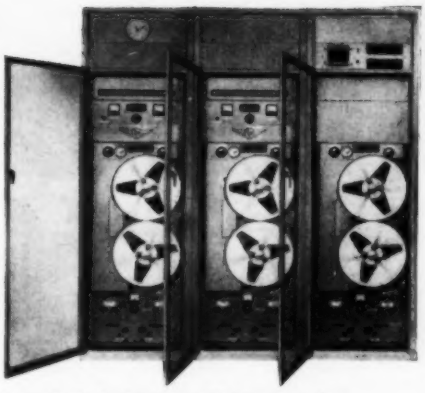
Closed-circuit visual and aural intercom over distances up to 1,200yd is provided by the Deccafax system produced by **Decca Radar Ltd.** Printed or handwritten material can be transmitted and modified, using 10in combined receiving and transmitting screens.

Many companies produce industrial closed-circuit television equipment, which has obvious applications at airports. At London Airport two **Marconi** BD871 television cameras are installed on lighting standards to give the marshalling supervisor a view of distant parking areas. **Pye Telecommunications** offer a radio-directed television system in which the camera is controlled by a UHF radio link and the picture is transmitted to the receiving station over a microwave television link.

Though not basically electronic equipment, the document-transmitting system developed by **Dialled Despatches Ltd** may appropriately be included in this section. By its use, letters, documents and any article that will fit into carrying cylinders of 1.8in diameter (a 4.5in system is also available) can be sent through a plastic tube at speeds between 20 m.p.h. and 30 m.p.h. The carriers are "homed" to various receiving stations by an ingenious dialling system which causes a tuned reed to vibrate at a particular frequency. At the approach to each station is a microphone coupled to a tuned circuit and having an amplifying system corresponding to the chosen frequency. When the microphone receives the correct note it operates a relay which diverts the carrier to the appropriate station.



Racal RA.129 radio teleprinter receiver



Thermionic Products type III tape-recorder

BEA are to have the system installed in the new terminal at Ringway, Manchester, a "ring main" covering ten such important stations as flight clearance, apron, engineering and emergency control points. Up to 45 stations can be served by an installation of this type.

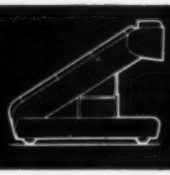
Public-address Systems

Manufacturers of public-address systems suitable for airport use include **Associated Electrical Industries, General Electric Co Ltd, Goodman Industries Ltd, Philips Electrical Ltd, Pye Telecommunications Ltd, Redifon Ltd, Standard Telephones & Cables Ltd, Tannoy Ltd, W.S. Electronics Ltd,** and **Westrex Company Ltd.**

Control Consoles

In addition to the control desks for air traffic controllers available from equipment manufacturers, **International Aeradio Ltd,** can supply any type of console, of standard designs or specially tailored to meet individual requirements for traffic processing and communications. Makers of headsets include **Airmed Ltd, Amplivox Ltd** and **The Anticoustic Co.**

PART THREE
APRON EQUIPMENT



General

In addition to the individual suppliers to whom reference is made in this section, **Aerocontacts (Ground Equipment) Ltd** offer an overall service through which an airport or airline operator can obtain all equipment required for apron, workshop or hangar use, "literally from a screwdriver to a refueller."

Air Conditioning and Cabin-pressure Testing

For many years the **M.L. Aviation Co Ltd** have been associated with air-conditioning ground units, and typical of their range is the M.L. Coolair Mk 6, which, state the company, BEA have selected for use with their Vanguards and Comets. Claimed to be "the most efficient and fastest aircraft cooling unit available today," the Mk 6 delivers 2,500 cu ft/min against 16in w.g. pressure, with a maximum cooling capacity of 240,000 BThU/hr under ambient conditions of 110°F and 69 per cent RH. Power is provided by a Perkins industrial diesel which simultaneously drives the refrigeration compressor and the delivery fan. Automatic electrical control system is provided. M.L. also produce pressure-testing equipment.

Dragonair Ltd are well known as makers of oil-fired mobile air heating units for engine and cabin pre-warming, and the latest of these is the Dragon Type DQLA250. Mounted on a trailer, this will, it is stated, adequately pre-warm a medium-sized (50 passenger) aircraft in approximately 30min. Single or multiple hoses can be attached for warming engines and cabins either separately or simultaneously.

Widely used on airports is the R-2000 air conditioning trolley made by **Sir George Godfrey & Partners Ltd.** This is a versatile unit for cooling, heating and pressure testing, and provision is also made for introducing deodorants or fumigants into the air supply.

Normalair Ltd manufacture a light, compact, hand-propelled trolley which provides a means of carrying out pressure and vacuum tests on a wide range of pneumatically operated cabin pressure control equipment and aircraft instruments. Another versatile pneumatic test equipment is made by **I.V. Pressure Controllers Ltd** (see page 926).

Blackburn Engines Ltd make an Artouste-powered unit (see under heading "Ground Power Units") for air conditioning and pressure testing. **Bell's Asbestos & Engineering Ltd** supply air-conditioning hose, and **Bryans Aeroquipment Ltd** make instruments to test pressure-testing equipment.

Apron and Runway Cleaning

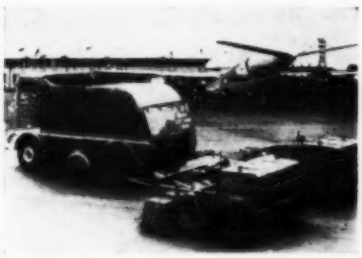
A tractor-drawn runway sweeper made by **Lewin Road Sweepers Ltd** is designed for gang operation and can be towed in pairs by their "Sweepmaster" sweep-collector, or in threes by a tractor using special attachments, when it will sweep a width of 20ft.

Zwicky Ltd make the Mk F.E.1-10 sweeper, capable of cleaning 72,000 sq yd of runway or apron in an hour, and other manufacturers of sweeping equipment include **Lacre Ltd** and **Alfred Miles Ltd.**

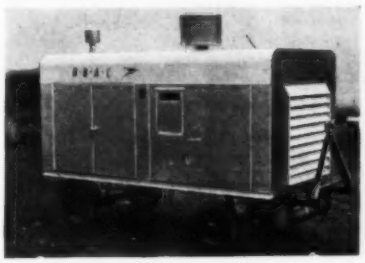
Loose metallic objects on the runway can be a particular hazard to jet engines and to tyres, and to counter this hazard the **General Electric Co Ltd** have developed a magnetic sweeper.

Mercury Airfield Equipment Ltd have recently been appointed official distributors in the UK and Eire of the Sicard SW.112 runway sweeper, two of which are shortly to go into service at London and Prestwick.

Snow clearance equipment and suction sweeper-collectors are specialities of **Rolba Ltd,** and among their latest equipment in this field is the rotary snow-plough attachment Type 100/70, designed for use in conjunction



Lewin runway sweeper/collector



Dragonair mobile cabin-heater

M.L. Coolair Mk 6 conditioning unit in attendance on BEA Comet 4

AIRPORTS AND GROUND EQUIPMENT

Rolba snowplough on Land-Rover

Ransomes 18in "Marquis" gang mowers in service at London Airport

Vernons 60kVA/12kW ground power unit (AEC diesel engine) in MoA service at Prestwick

Murex Type 9840 GPU for Turkish Airlines

with a Land-Rover specially converted for the purpose. It is designed to clear snow to a width of 6ft 7in and a weight of up to 400 tons/hr. Incorporating a centrifuge system designed by the former director of the Swiss Snow and Avalanche Research Institute, the machine loosens snow by means of rotary cutting knives and then passes it to ejecting wheels which throw it clear to a distance of up to 30ft. Power is provided by a take-off from the Land-Rover engine.

Douglas Equipment Ltd have developed an efficient snow-plough carrier which can be fitted with well-tried Swiss equipment.

Comparable with runway cleaning is the mowing of grass in the areas between runways and taxi tracks, and an old-established manufacturer of the necessary machinery is **Ransomes Sims & Jefferies Ltd,** who supply a variety of mowers, including a tractor-drawn triple-gang machine capable of cutting 5½ acres of average-length grass per hour.

Baggage and Cargo Handling

Rootes Motor Ltd supply Karrier Gamecock and Bantam chassis and Commer 5- and 7-ton chassis for practically every type of apron vehicle, the bodies or other special equipment normally being supplied by the various manufacturers mentioned in these pages. One vehicle of particular interest, based on a Karrier Gamecock chassis, is the Rootes aircraft baggage loader, which has two adjustable conveyor belts protruding forward of the vehicle and hydraulically operated from the gear box power take-off. The all-metal van body, constructed by Palmer Coachbuilders Ltd, is fitted with shelving to accommodate the baggage. It is stated that the vehicle can load or clear the baggage compartment of a PanAm Boeing 707 in under 10min.

A complementary vehicle is the Rootes Cargo Lift on a Commer 7-ton chassis, the van body of which is elevated to cargo-hatch height by means of scissors-action members.

A scissors-type "Aeroloader" is manufactured by **Dennis Bros Ltd,** and **Access Equipment Ltd** make scissors-action, hydraulically operated freight loaders which can be supplied with almost any type of truck chassis and a variety of platform- or van-type bodies. **Mercury Truck & Tractor Co Ltd** make a three-ton high-loading truck elevating to 11ft 3in, and **Douglas Equipment Ltd** have developed a baggage handler having an 18ft-long platform that can be raised through any height from 3ft 6in to 12ft.

An ingenious system of handling cargo or other articles has been developed by **E.M.I. Electronics Ltd** in the shape of the "Roboteg," which is a driverless electric tractor towing a train of trolleys and following a track determined by a wire which may either be laid on the ground or floor or buried beneath it. The system is operated by a single operator from a convenient control point and various safety devices are incorporated.

Wessex Industries (Poole) Ltd make numerous types of trailers, at least three of which, with 30-cwt and 3-ton capacities—are particularly suitable for airport use. The same company make a range of battery-operated trucks and tractors, for use with which the trailers are well suited. Other manufacturers of trailers include **H. W. Edghill & Co Ltd.**

An interesting approach to cargo-handling problems is the "Aircon" air transportable container developed by **Airtech Ltd** and already in use by the RAF. These lightweight, climate-resisting containers are designed with a chassis which makes them fully mobile, and they also provide an efficient means of storage whilst awaiting loading on to aircraft or delivery from an airport.

Well known for aircraft detail equipment, **King Aircraft Corporation** also enter the cargo-handling field with a new collapsible pallet system. The pallet is on castoring rollers and incorporates pneumatic action. With its load lashed in place it can be wheeled to the aircraft, fork-lifted to the cargo door and wheeled into position. Operation of a relief valve then collapses the rollers into the pallet structure, leaving the load evenly distributed on the aircraft floor. Weight of a 4ft × 5ft pallet for a load of 1,500lb is approximately 60lb.

Loading Conveyor Belts

Fourways (Engineers) Ltd produce battery-driven trucks with a hydraulic conveyor boom, adjustable to 13ft in height. Among manufac-

Conveyancer fork truck with baggage train

Airtech Ltd "Aircon" freight container on transport chassis

Lansing Bagnall diesel tractor and freight train

Access Equipment Ltd freight loader on Rootes Commer chassis for BOAC

Simon Engineering hydraulic platform on defrosting duty

Ford Thames passenger coaches in service with BOAC

Right, AEI low-pressure starting unit utilizing steam

turers of normal fixed roller-type conveyor belts are Herbert Morris Ltd, whose products can incorporate curves of 45° or 90° (see also page 925.

Silencers and Blast Screens

Currently in production by **Auto Diesels Ltd** is a range of Bertin transportable jet-engine silencers for use on airport aprons.

Though now largely occupied with the manufacture of vibration-damping equipment and operation of a shock and vibration laboratory, **Cementation (Muffelite) Ltd** continue their work in the silencing field, and a mobile muffler is among their products. **Cullum Detuners Ltd** and **Horace W. Cullum and Co Ltd** are also names well known in connection with jet-engine silencing developments.

Flight Refuelling Ltd have a licence agreement with Curtiss-Wright for manufacture of the latter's mobile noise-suppressor, suitable for any turbojet of up to 330lb/sec mass flow.

Reinforced concrete blast screens are a speciality of **The Modular Concrete Co Ltd.**

Defrosting Equipment

When aircraft are parked in the open under severe winter conditions, de-icing is a vital preliminary to take-off. **Kilfrost Ltd** supply the necessary fluids; typical grades are Kilfrost arctic de-icing fluid, and hoar-frost remover G.17. There is also D.C.2A de-frosting compound, which is diluted with water and sprayed hot.

Applications of anti-icing fluids to certain parts of aircraft, notably high tail-units, can present considerable difficulty, and BEA is one of the operators who have overcome the problem by employing the Simon hydraulic platform, which gives a 40ft elevation and 26ft horizontal reach. The manufacturers are **Simon Engineering (Midlands) Ltd.**

Trolley-type dispensers for de-frosting are produced by **Rollason Aerocessories Ltd** and **Zwicky Ltd.**

Engines

Apart from vehicles—cars, vans, trucks, coaches and tractors—used in airport work, the **Ford Motor Co Ltd** supply both petrol and diesel engines to power a wide variety of airport equipment, ranging from cooling units to mobile cranes.

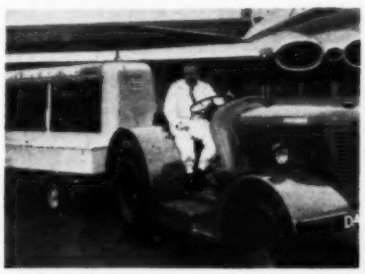
Fork-Lift Vehicles

The trucks of **Conveyancer Fork Trucks Ltd** have for many years been well known in aviation. On airport aprons, these trucks are commonly used with a train of trailers which they have themselves loaded and which on reaching the aircraft are elevated one by one to the height of the cargo door. The company has recently introduced a new range of electric trucks and tractors which they consider will be of value for airport work.

Electrically powered fork-lift trucks (nine models, with capacities of from 1,000 to 8,000lb) and diesel-powered models (seven types, from 2,000 to 7,000lb) are made by **Coventry Climax Engines Ltd.** The newest model in this range is the powerful Universal Major. For all these types there is a wide variety of attachments for special loads.

Added to the range of **Lansing Bagnall Ltd** fork-lift trucks there is now a vehicle designed to overcome a disadvantage of the battery-operated type of truck for airport use, i.e., its comparative slowness. The Lansing Bagnall "Rapide" travels at up to 7 m.p.h. on a 24V supply, and the second half of the accelerator pedal travel brings in a 48V supply for higher speeds. There are two models, with lifting capacities of 2,000lb and 3,000lb.

Auto Diesels ground power unit in attendance on Air France Caravelle



David Brown Taskmaster tractor and Murex ground power unit

Blackburn gas-turbine GPU on Standard Commer 15cwt vehicle

Mercury Airtug 160L Mk 2 tractor (Leyland 11-litre engine)

Matbro Ltd manufacture a range of sturdy fork-lift trucks with capacities ranging from 4,000lb to 10,000lb, and other manufacturers of equipment in this field include **I.T.D. Ltd** (makers of the Stacatruc), **Ransome, Sims & Jefferies Ltd, Stockport Manufacturing Co Ltd** and **Wessex Industries (Poole) Ltd.**

Passenger Steps

Very completely equipped passenger steps are made by **H. W. Edghill & Co Ltd** and have been supplied to a number of well known operators. Known as the Autostair, this self-propelled equipment is hydraulically adjustable through a wide range and incorporates such refinements as flush lighting, destination boards and a shelter roof. Edghill also make a variety of simpler steps.

The mobile stairs made by **C. F. Taylor (Metal Workers) Ltd** are in two models (13 and 15 treads) which can be elevated hydraulically to 10ft 5in and 11ft 6in respectively. Equipment includes electrical illumination of the steps.

Other manufacturers of airline passenger steps include **Heston Aircraft & Associated Engineers Ltd, Mercury Airfield Equipment Ltd, Red Devon Ltd** and **Spurlings Ltd.**

Toilet Servicing

Norstel & Templewood Hawksley Ltd now manufacture the range of toilet servicing equipment, formerly made by A.S.T.; another manufacturer of this type of equipment is **H. W. Edghill & Co Ltd.** Hoses for such duties are made by **Bell's Asbestos & Engineering Ltd.**

Ground Power Units

Atlas Copco (Great Britain) Ltd market the "Air Partner," based on the use of the Lysholm type of rotary-screw compressor and driven by a variety of petrol and diesel engines. The larger of the two models has twin compressors, making it suitable for starting, full air-conditioning, de-icing and auxiliary-system checks.

Auto Diesels Ltd make a range of starting and servicing equipment comprising 28V and 112V single-voltage and dual-voltage GPUs; 28V battery starting trolleys; 400c/s and 2,400c/s servicing units; and the "Aydee" gas turbine air starter.

Houchin Ltd include in their GPU range a powerful diesel-powered servicing unit capable of giving 1,200A continuous at 28.5V; BEA have ordered this model for their Vanguard and Comet fleets.

Aircraft Ground Equipment Ltd make a wide range of test and starting equipment, both trailer mounted and self-propelled.

The two principal types of ground starting equipment supplied by **Murex Welding Processes Ltd** are the Type 8940, which supplies 600A continuous at 28V or 700A at 28V for 15min, with a 2,000A starting current. The Type 9360 is a dual-voltage type suitable for engine starting and pre-flight checks on large civil aircraft such as the Comet, Caravelle and Britannia.

Petbow Ltd manufacture an extensive range of GPUs, from a 270A continuous at 28V to large diesel models with outputs of up to 2,000A at 28V.

Red Devon Ltd are another producer of ground starting equipment, a typical set giving 1,500-1,600A at 28.5V.

It is the claim of **Vernons Industries Ltd** that they were the first company in Europe to introduce a GPU with a brushless a.c. generator and transistor voltage regulator. All the sets in the range—from 15kVA to 150kVA—consist essentially of an alternator driven by either a synchronous motor or an I.C. engine. The units can be trailer- or lorry-mounted, or self-propelled, or used as static sets. The most powerful units in the range are those designed for large jet and turboprop aircraft such as the Vickers VC10, Boeing 707 and Bristol Britannia.

[*Continued overleaf*

AIRPORTS AND GROUND EQUIPMENT

Small gas turbines are finding increasing use as powerplants for apron equipment and **Blackburn Engines Ltd** supply a versatile vehicle utilizing the Blackburn Artouste 510 engine. Air power can be supplied for main engine starting, cabin pressure testing, air conditioning and a.c. and d.c. electrical testing; hydraulic power can also be provided. Blackburn powerpacks utilizing either the Palouste or the Artouste engine are supplied in several forms for a variety of purposes.

The small power units made by **Rover Gas Turbines Ltd** have found a number of applications for ground equipment, their uses including electricity generating and water pumping. A complete lightweight ground power unit is also made and can be used for ground servicing where both electrical power and low pressure air are independently required in addition to aircraft starting facilities.

In addition to electrical starting and servicing equipment, **Associated Electrical Industries (Rugby) Ltd** have developed a most unorthodox ground starting unit for which power is provided by steam generated in a flash evaporator, as described on page 832 of *Flight* for November 25. The steam, which is at similar temperature and pressure conditions to those at present used in low-pressure air starting systems, is fed by hose to the aircraft starter turbine in the conventional manner. The unit is mounted on a Land-Rover.

Another out-of-the-ordinary type of starter equipment is the "Jetstart," by **I.V. Pressure Controllers Ltd.** Utilizing a battery of air bottles with special valving equipment, this trolley is stated to be suitable for starting the engines of the largest jet airliners. A description appeared in *Flight* for August 26, 1960.

Hoses for use with low-pressure-air starting systems are made by **Bell's Asbestos and Engineering Ltd.**

Rectifier-type starting and servicing equipment, drawing its power from the mains, is made by the **General Electric Co Ltd, Partridge, Wilson & Co Ltd, Standard Telephones and Cables Ltd** and **Westinghouse Brake and Signal Co Ltd.**

Douglas Tugmaster tractor

Tractors

David Brown, whose experience of building aircraft tractors dates back to 1940, claim to be Europe's largest manufacturer of this type of machine.

The current Taskmaster range, built by **David Brown Construction Equipment Ltd,** comprises three machines. The smallest is a petrol or diesel engine model capable of handling aircraft up to a gross weight of 50,000lb under average conditions; then comes the Turbo Taskmaster (petrol or diesel) the transmission system of which allows this relatively low-powered tractor to develop a high drawbar pull, so that under favourable conditions it can handle aircraft of up to 120,000lb; and thirdly there is the Turbo Taskmaster Super, identical with the last-mentioned machine except that it incorporates twin rear wheels and has facilities for carrying ballast to increase adhesion. The drawbar pull obtained as a result enables it to handle aircraft of a towing weight of up to 157,000lb.

An extremely powerful tractor now in production for service with operators of the largest aircraft is the Tugmaster, made by **Douglas Equipment Ltd.** Giving a tractive effort of 32,000lb, it will handle aeroplanes of up to some 310,000lb gross weight.

Another high-powered tractor, made by **Mercury Truck & Tractor Co Ltd,** is the Airtug 160L Mk 2. Propelled by a Leyland 11-litre engine, it has a transmission system incorporating a fluid flywheel and five-speed air-operated self-changing gearbox and gives a rated drawbar pull of 20,000lb. This vehicle, state the makers, will tow aircraft up to the size of the Boeing 707. Both Douglas and Mercury also supply smaller tractors for such duties as hauling baggage trains.

A useful general-purpose tractor is the **Lansing Bagnall** TD100 diesel-engined machine, which will haul 15-ton tows at up to 20 m.p.h.; economy—10hr on 1gal of fuel is quoted—is a characteristic.

Weighing Equipment

Certain of the well-known weighing machines made by **George Salter & Co Ltd** are particularly suitable for airport use—notably the Type 218 for passengers and the platform Type 113T for cargo.

PART FOUR
FUEL, OIL, ETC., SERVICING

Fuellers

Designers and manufacturers of tanker equipment for very many years, **Thompson Bros (Bilston) Ltd** have been responsible for much of the equipment in use at airports throughout the world. New refuellers commissioned by Esso for supplying the big jets are an example of their products. These "Python" Mk 2 refuellers weigh approximately 65 tons when fully laden with 12,000gal of fuel, which the pumps can supply at rates of up to 1,000gal/min; they can also defuel an aircraft at 80gal/min. The chassis is an eight-wheeled **Foden** tractor unit powered by a 200 b.h.p. Rolls-Royce diesel and the tank itself is supported at the rear on another four wheels.

The **Leyland Motors Ltd** group, in collaboration with the fuel companies and specialist tank manufacturers, produce an extensive range of refuellers. Among the type-names and typical tank capacities are the Beaver, 2,000gal; Dorset, 3,000gal; Octopus, 4,000gal; Scammell Mountaineer, 5,750gal; and Hippo, 8,000gal (with trailer tank).

Saro (Anglesey) Ltd both design and manufacture tanks and tank trailers for refuellers, and a recent product is the 5,750gal tank for the Scammell Mountaineer mentioned above and in service with Air BP. They were also responsible for the trailers of the same fuel company's 10,000gal Yorkshire refuellers, on chassis by **Associated Equipment Co Ltd.**

Hydrant Fuelling

Well known as makers of aircraft fuelling equipment, **Zwicky Ltd** have lately been paying special attention to hydrant systems, and a vehicle illustrated on page 923 is the "Jet-Stream" hydrant dispenser for supplying the big jets. Received through a 4in intake, the flow is divided into three independent branches precisely controllable and provided with filter and water separator units. One hose line provides fuel at 150 Imp gal/min and the others at 250 Imp gal/min. Defuelling equipment is also provided.

Rellumit (London) Ltd make the Commando hydrant dispenser vehicle, developed for and in connection with Air BP. For underwing pressure fuelling of big jet aircraft it can supply 200gal/min from each of its two forward hoses and 300gal/min from each of two top-deck hoses.

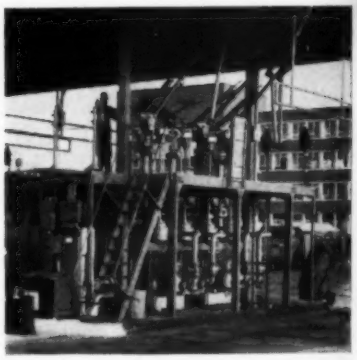
Truro Engine Works Ltd offer a range of gasoline and kerosine dispensers for hydrant systems, and are also able to undertake the installation of complete systems at airports and elsewhere.

Hydrant dispensers, hose carts and associated equipment are made by **Simmonds Aerocessories Ltd,** some of these products being manufactured under licence from the Pryor Mfg Co of Mansfield, Ohio.

Simmonds—a member of the Firth Cleveland Group—now have mobile teams of service engineers to enable the company to take full responsibility for the maintenance of the airfield equipment they have supplied. The teams—established as a result of similar services for Admiralty establishments—are equipped with test gear, ventilating blowers, explosometers, spark-proof tools and fuel-proof clothing. They are qualified to maintain all products of the Firth Cleveland Group and work in close co-operation with other suppliers of airfield equipment.

Hydrant fuelling dispensers are produced by **Wayne Tank & Pump Co** to meet individual requirements. The company also manufacture metering equipment (see opposite).

Much of the detail equipment used in modern hydrant systems is supplied by **Avery-**



Bulk tanker-loading installation for Shell-Mex and BP at London Airport (Wayne Tank and Pump Co)

British Oxygen Aviation Services 75-litre lox dispenser

12,000gal Python refueller for Esso, by Thompson Bros (Bilston) Ltd, on Foden chassis

Scammel Mountaineer with 5,750gal bridging tanker by Saro (Anglesey) Ltd for Air BP

Zwicky "Jet-Stream" hydrant dispenser

Simmonds "Aerolube" oil dispenser

Hardoll Ltd, ranging from 4in hydrant pits with quick-release valves to various fittings on such dispensers as the Zwicky Tagus.

Filtration Equipment

Stream-Line Filters Ltd number among their products various filters which find a place in airport refuelling systems and vehicles. The K-type filter passes the fuel through specially prepared paper discs compressed by springs; back-flushing with clean fuel eliminates contamination from the fuel packs, which have a life of several years. Any water in the fuel causes the paper to swell, with a consequent increase of back pressure that indicates that servicing is needed. There are also the high-output MC filter, conveniently small in size in relation to output; and three-stage filters and water separators, which use pleated elements of paper, Fibreglass and nylon.

Simmonds Aerocessories Ltd supply a wide range of Fram strainers, micronic filters and water separators, made by them under licence from the Fram Corporation, of Providence, RI. Other manufacturers of filtration and water-separation equipment include **Rellumit (London) Ltd, Tecalemit Ltd, Thompson Bros (Bilston) Ltd** and **Zwicky Ltd.**

Metering Equipment

Wayne Tank & Pump Co Ltd make the Wayne-Smith bulkmeters and flowmeters, which are extensively used both in bulk supplies and on refuelling vehicles. The company recently provided all the meters for the fuelling trolleys used at the new Copenhagen Airport, whilst the refuelling cabinet and metering equipment at Battersea Heliport was supplied by them to Shell.

Bulkmeters are among the wide range of refuelling equipment made by **Avery-Hardoll Ltd,** and **Firth Cleveland Instruments** supply numerous different types of contents-gauging equipment.

Among other suppliers of metering apparatus are **Tecalemit Ltd** and **Thompson Bros (Bilston) Ltd.**

Valves and Couplings

Though best known, perhaps, for their airborne equipment, **Flight Refuelling Ltd** manufacture a number of detail items used in fuelling. An example is the 4in hydrant valve and coupling, which is in effect a reducing valve giving constant pressure for dispensers and/or tankers, irrespective of the number of fuelling points from any one hydrant. Valves of this type are shortly to be used by the oil companies' consortium supplying fuel at Paris-Orly. Other items in a wide range made by Flight Refuelling include the Mk 41 valve, suitable either for refuelling or defuelling; flow-rate is up to 240gal/min.

Almost every type of valve, coupling and hose found in typical aircraft refuelling systems is available from **Avery-Hardoll Ltd,** and other manufacturers in this field include **Thompson Bros (Bilston) Ltd, Rellumit (London) Ltd., Simmonds Aerocessories Ltd** and **Wayne Tank & Pump Co Ltd.**

Oil Dispensers

Lubricating-oil bowsers of various types, with metering equipment, are supplied by the **Steel Barrel Co Ltd, Thompson Bros (Bilston) Ltd, Tecalemit Ltd, Truro Engine Works Ltd,** and other manufacturers.

Oxygen and Water/Methanol Replenishing Equipment

Oxygen servicing equipment to meet the new MoA requirements for the provision of oxygen for crews and passengers has been developed by **British Oxygen Aviation Services.** They are now producing 75-litre and 50gal vacuum insulated lox dispensers for apron use, together with 500gal tanks for bulk storage at airports. In addition there is a transportable plant, powered either electrically or by a diesel engine capable of producing 1,000 cu ft of oxygen per hour in gaseous or liquid form.

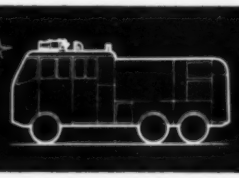
Truro Engine Works Ltd make a variety of water/methanol dispensers; one example is the 120gal Medway, as supplied to Shell International.

Among other manufacturers of replenishing equipment apart from fuellers are **H. W. Edghill & Co Ltd, Mercury Airfield Equipment Ltd** and **Red Devon Ltd** and the **Steel Barrel Co Ltd.**

Suppliers of Fuels and Oils

Air BP (British Petroleum Co Ltd), BP House, Ropemaker Street, London EC2. T: National 1200.
Castrol Ltd, Castrol House, Marylebone Road, London NW1. T: Hunter 4455.
Duckham & Co Ltd, Alexander, Hammersmith, London W6. T: Fulham 3300.
Esso Petroleum Co Ltd, Aviation Dept, 50 Stratton Street, London W1. T: Hyde Park 7030.
Gulf Oil (Great Britain) Ltd, 6 Grosvenor Place, London SW1. T: Belgravia 5011.
Manchester Oil Refinery (Sales) Ltd, 76 Jermyn Street, London SW1. T: Whitehall 8411.
Mobil Oil Co Ltd, Caxton House, Westminster, London SW1. T: Whitehall 1010.
Ragosine Oil Co Ltd, Minerva Works, Woodlesford, near Leeds, Yorks. T: Rothwell 2164.
Regent Oil Co Ltd, 117 Park Street, London W1. T: Mayfair 8474.
Royal Dutch/Shell Group of Companies, St Helen's Court, Great St Helen's, London EC3. T: Avenue 4321.
Shell-Mex & BP Ltd, Shell-Mex House, Strand, London WC2. T: Temple Bar 1234.

PART FIVE
EMERGENCY EQUIPMENT
(including Protective Clothing, etc.)



Ambulances

Petrol- and diesel-engined ambulances are among the various types of vehicle manufactured by **Dennis Bros Ltd.**

Crash/Fire Equipment

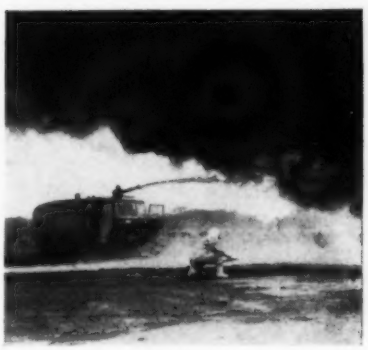
Foamite Ltd have fulfilled a number of Air Ministry orders for their Mk VI airfield crash tender, which is mounted on the **Alvis** Salamander chassis; this has six wheels—three on each side, evenly placed, independently sprung and all powered from the 240 b.h.p. Rolls-Royce eight-cylinder engine. With a tank-like capability of crossing rough ground, the tender carries 700gal of water and 110gal of foam compound, the mixture being projected from a monitor on the cab roof and/or from hoselines. The monitor can project 2,500gal to over 90ft and the hoses an additional 3,000gal/min with a range of 70ft. The total output can be discharged in less than 2min. Other fire-fighting equipment includes 24gal of CBM and a powered rescue-saw.

Alvis Ltd are manufacturers of the Salamander crash/fire tender chassis as used in the appliances made by Foamite Ltd (see above) and the Pyrene Co Ltd.

The Pyrene Co Ltd supply fire-fighting appliances ranging from small foam tenders and dry chemical tenders—these utilize the **Land-Rover** chassis—to heavy-duty vehicles equipped to discharge 12,000gal of foam in under two-and-a-half minutes.

Merryweather & Sons Ltd is a pioneer name in fire-fighting, but the tenders which this

Foamite tender (Alvis Salamander chassis) in action using cab-roof monitor



Left, Dennis F29 appliance used to protect BEA engineering base at London Airport

Below, Rover gas-turbine fire pump unit

Pyrene Mk VI fire/crash tender on Alvis Salamander chassis

Sun fire/crash tender on Thornycroft chassis with Rolls-Royce engine

Fire Armour Ltd Firefly crash/fire tender

Resuscitation equipment by Walter Kidde Co

AIRPORTS AND GROUND EQUIPMENT . . .

company supplies for airfields are thoroughly up-to-date in performance and equipment.

Designed by **Sun Engineering (Richmond) Ltd.** in conjunction with the MoA, a fire appliance illustrated on this page carries a 540gal water tank, 100gal foam compound tank (7,000gal/min), 12 × 50lb CO_2 cylinders and very complete ancillary equipment. Powered by a Rolls-Royce B.81 engine in a 6×6 **Thornycroft** chassis, it is capable of up to 60 m.p.h.

Fire Armour Ltd manufacture fire-fighting and rescue vehicles of many sizes, and often these are designed to suit local requirements. A photograph on this page shows a Firefly tender of a type which has been supplied to several major airports in the Commonwealth. A feature of these vehicles is that they are as useful for the protection of airport buildings as for fighting crash fires. In all designs there is concentration on securing maximum foam discharge-rate. Fire Armour also produce jeep-type vehicles which include electric generators for supplying power to rescue-saws and for floodlighting the crash area.

Dennis Bros Ltd make a number of types of fire appliances, a typical example being the F.29 airport vehicle illustrated. Equipment includes a 300gal water tank, 35gal foam compound tank and 4 × 50lb CO_2 cylinders.

Other suppliers of crash/fire tenders include **A.F.P. Engineering Ltd, Douglas Equipment Ltd, General Fire Appliance Co Ltd** and **Red Devon Ltd.**

Well known for many years for airport fire-fighting equipment, the **Walter Kidde Co Ltd** include in their range of equipment several types of hand-truck CO_2 extinguishers for attendance on aircraft during starting up. The largest of these extinguishers gives a 900 cu ft free-gas discharge. There is also a range of hand extinguishers.

For airports with areas of water on or near the boundaries, the **R.F.D. Co Ltd** supply the Zodiac rescue boat, powered by an outboard engine. This inflatable craft can be quickly transported to any convenient point and launched. Inflatable life-rafts can be used to give additional rescue capacity. Also made by R.F.D. are lifting bags of four-ton or 12-ton capacity to assist in salvaging aircraft which have made wheels-up landings.

Special-purpose Land-Rovers for fire-tender and other airfield duties are supplied by **R. J. Searle Ltd.**

The mobile floodlighting equipment made by **Harley Aircraft Landing Lamps** (see page 916) fulfils a valuable purpose in the event of crashes after dark.

Runway Clearance

"Tracjacs" of up to 30 tons capacity for the quick removal of crashed aircraft are made by **Skyhi Ltd,** who will shortly have available a new type capable of handling the largest commercial aircraft.

John Curran Ltd manufacture a 60-ton mobile crane specially designed for the salvage of aircraft in the 150-ton class, together with other items of clearance equipment. Other crane manufacturers (see page 925) include **Anderston Clyde Engineers Ltd, K & L Steelfounders & Engineers Ltd** and **Steels Engineering Products Ltd** (makers of the Coles crane).

Protective Clothing

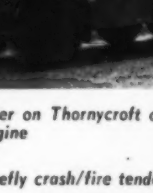
Makers of protective clothing—some of it for emergency use, some to give protection against deleterious industrial processes—include **Siebe, Gorman & Co Ltd, Baxter, Woodhouse & Taylor Ltd, Bell's Asbestos & Engineering Ltd** and **P. Frankenstein & Sons (Manchester) Ltd.**

The **R.F.D. Co Ltd** manufactures anti-kerosine clothing for refuelling crews.

Sonex ear defenders, giving an attenuation of 15-30db, are made by **Amplivox Ltd** and are in use at LAP and other airports. Headsets incorporating ear defender fittings are also part of the Amplivox range of this type of equipment. Other manufacturers of hearing-defence equipment include **Airmed Ltd, The Anti-coustic Co** and **Siebe, Gorman & Co Ltd.**

Breathing apparatus may fittingly be included in this section, and among its manufacturers are **Siebe, Gorman & Co Ltd** and **Normalair Ltd.** The **Walter Kidde Co Ltd** supply oxygen resuscitation sets.

PART SIX
MAINTENANCE EQUIPMENT



Access Equipment

Design and installation of maintenance docks is a speciality of **Rodger, Setterington & Partners, Heston Aircraft & Associated Engineers** and **Tiltman Langley Ltd.**

Among the many types of apparatus made by **Access Equipment Ltd** are the "Giraffe" hydraulic work-platform, in models giving heights up to 42ft; the "Safety Raiser," a scissors-action, hydraulically operated platform in varieties which can be built to special requirements; and "Zip-up" aluminium-alloy staging, which can be erected to heights of 100ft or more without the use of nuts, bolts or assembly tools.

An associated company of the **Mercury Truck & Tractor Co, Mercury Airfield Equipment Ltd,** include among their products a multi-level platform with a height range of from 7ft to 40ft. Hydraulically operated, the unit has particular value for reaching high tail units.

Anderston Clyde Engineers Ltd make a variety of access equipment under the names "Move-on" and "Spaceman." The former are simple mobile devices, in two models with working heights of 11ft and 16ft, which the operator is able to propel by means of a handle on the platform. The latter, in four models giving heights from 21ft to 40ft, is hydraulically operated (plus electrical power if required) and is of a particularly compact nature when in the retracted position.

From the **Thames Packaging Equipment Co** comes the "Mobiliftor," a one-man platform which can be elevated to a height of 25ft by means of an air compressor driven by a single-cylinder engine. Both towed and self-propelled models are made. A maintenance platform with a maximum height of 13ft is manufactured by **Murex Welding Processes Ltd.** Three sizes are available, and operation is hydraulic. A versatile piece of access equipment is the **Simon** hydraulic platform, referred to under the heading "De-frosting Equipment" on page 921.

One of the most familiar sights in airport maintenance shops is Dexion slotted angle;

its uses include the construction of maintenance docks, mobile gantries, assembly jigs, trolleys and work benches. At London Airport, state **Dexion Ltd**, BOAC alone have to date used some 100,000ft of this material.

Cranes and Hoists

Made by **Anderston Clyde Engineers Ltd** is the "Colossus" mobile gantry, a highly adaptable device capable of lifting loads of from one to 30 tons, or up to 100 tons to special order; hand-operated chain hoists or electrical hoisting gear is used as required.

K & L Steelfounders & Engineers Ltd are manufacturers of the Jones mobile crane, which is widely used both by airport contractors and operators. At the last SBAC Show over 200 tons of equipment valued at over £1½m was handled by a single Jones crane during the assembly and dismantling period. These cranes are distributed and serviced in the UK by George Cohen Sons & Co Ltd, of London W12.

An old-established manufacturer of cranes for lifting aircraft is **Steels Engineering Products Ltd**, who make the Coles crane. As noted in the "Emergency Equipment" section of this review, **John Curran Ltd** make a 60-ton mobile crane.

Jacks

Skyhi Ltd manufacture a full range of hydraulic jacks, capacities ranging from two tons to 80 tons. Fitted with either tripod or quadrupod feet, they can be operated—in addition to hand operation—by electric motors or by compressed air from the service lines normally available in overhaul shops. There is also a range of wheel-change jacks of from two tons to 50 tons capacity, the larger sizes being air-operated if required.

A particularly useful variant of the jack is the jacking castor, various types of which are made by **Flexello Castors & Wheels Ltd** and **Autoset (Production) Ltd.**

Mechanical Handling Equipment, Miscellaneous

Wheel skates for the easy manoeuvring of large aircraft in confined spaces made by **Skyhi Ltd**, who also have a range of track jacks (see page 924).

Mechanical handling equipment is a speciality of **Herbert Morris Ltd**, and among their products are roller conveyor systems of the type illustrated in a photograph on this page. Conveyors and elevators are among the products of **Gordon & Co**, who are engineers and consultants responsible for a wide range of maintenance equipment built to customers' requirements. What might be termed a miniature fork-lift truck, hand-propelled and with hydraulic lift for loads up to 300lb, is the Sherpa Junior, a new product of **Salisbury Precision Engineering Ltd**; many larger models, together with power trucks and trailers, are also made. Of value in the larger types of maintenance organization is the **E.M.I.** "Robotug" (see page 920).

Positioning Equipment, Engine Stands, etc.

Murex Welding Processes Ltd, through their subsidiary company Donald Ross and Partners Ltd, supply various kinds of positioning equipment, from small bench models suitable for servicing electrical and lightweight assemblies to large positioners enabling major components to be set in any position required.

Herbert Morris Ltd roller conveyors in EOAC engine overhaul shops

In association with **Air-Log Ltd, Auto Diesels Ltd** are manufacturing a range of engine-handling trolleys. This equipment—described in some detail in *Flight* for November 11—consists of a positioning trolley, transportation and works stand, the powerplant being easily transferred on roller gear from one unit to another.

Engine and aircraft servicing equipment is a speciality of **Morfax Ltd**, who have given a great deal of attention to the production of equipment for specific types of engine—notably the Dart and Tyne—and aircraft. Items from their engine range include a hydraulically operated work platform for the stripping and assembly of large turbojets and turboprops in the vertical position; servicing, parking and road transport stands for gas turbines; and roll-over stands, including a model which permits the engine to be rotated in two planes. The aircraft range includes 14 items of maintenance equipment for the Viscount and four for the Vanguard.

Hydraulic lifting tables, hand or electrically operated (mains or battery), with one- and two-ton capacities, are made by **Salisbury Precision Engineering Ltd.**

Test Equipment

Heenan & Froude Ltd design and manufacture engine test plant of all types, including thrust-measuring stands (as used by BOAC for the Avon and Conway); complete engine test plants and dynamometers (as supplied to BEA for Dart and Tyne testing); torque reaction stands (PIA use these for Dart testing); cable-suspended hangar stands; and helicopter engine test plant.

Though much of their development work has been concerned with the military-aircraft field, **John Curran Ltd** number among their products several items of value to those operators of civil aircraft who have their own engine-maintenance facilities, and among these are test stands for piston, turboprop and turbojet engines. A typical design is the Type T torque-measuring test stand originally developed for the Dart and now completely redesigned as the Mk 2, for engines developing up to 7,000 s.h.p. Among users of Curran turboprop stands are Middle East Aircraft Servicing Co (Dart and Proteus), Aircraft Carriers Engineering Services, Miami (Proteus) and South African Airways Corporation (Dart).

Apart from other ground power units (see page 921) **Vernons Industries Ltd** make test equipment and are currently supplying a number of rigs for testing the alternators and Sundstrand drives of the Boeing 707, Vickers VC10 and Bristol Britannia. One such rig, installed at London Airport for BOAC, is installed in a specially constructed building with a control room on the upper floor separated from the test cell.

Trailer-mounted motor generating sets for testing aircraft electrical systems are manufactured by the Heavy Plant Division of **Associated Electrical Industries Ltd.** Rated respectively at 90kVA and 40kVA, these sets are designed for outdoor and indoor use. Among much other AEI test equipment is an electronic leak detector for testing pneumatic systems and an electronic ignition-tester for piston engines.

Another well known manufacturer of test equipment for turbine and piston engines is the **English Electric Co Ltd,** and engine testbeds and associated equipment are made by **Gordon & Co.**

Almost all the manufacturers listed on pp. 921-922 as makers of ground power units supply system-test units for maintenance-shop use.

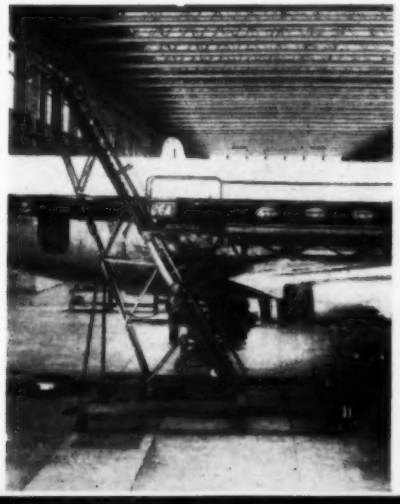
Hydraulic-system test rigs and associated equipment built to operators' requirements are the speciality of **H.M.L. (Engineering) Ltd.** Electric and hydraulic test rigs, trailer-mounted or self-propelled, are made by **Aircraft Ground Equipment Ltd.**

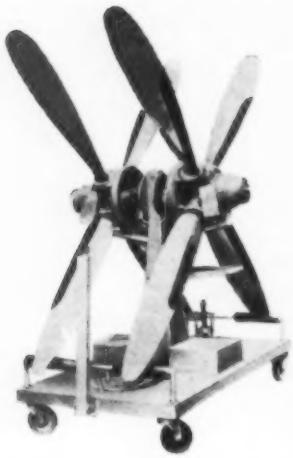
A simplified method of providing air and/or nitrogen over a wide pressure range for aircraft maintenance-shop test purposes is provided by the mobile air distribution panel made by

Mobile gantry constructed from Dexion angle

"Mobilift or" (Thames Packaging Equipment)

Mercury Airfield Equipment platform





Propeller transport trolley for Viscount, by Morfax Ltd

Normalair trolley for use in pressure and vacuum testing

I.V. Pressure Controllers Ltd mobile air-distribution unit

I.V. Pressure Controllers Ltd. This equipment was described in some detail in *Flight* for October 28. From **Normalair Ltd** comes the lightweight pneumatic test equipment referred to on page 919, and other test gear is made by **Bryans Aeroquipment Ltd** (particularly for the verification of aircraft instruments), **Graseby Instruments Ltd, Ultra Electronics Ltd, Cossor Radar & Electronics Ltd, Elliott Bros (London) Ltd, Armstrong Whitworth Equipment, English Electric Co Ltd, Goodmans Industries Ltd, Staravia Ltd** (of Church Crookham, Aldershot, Hants) and others.

Portable equipment for the radiographic examination of aircraft components are a speciality of **Research & Control Instruments Ltd,** sole UK distributors of Muller industrial x-ray apparatus. In their latest equipment of this kind the company have co-operated with BOAC's non-destructive testing unit at London Airport and it has been found that considerable economies can be achieved, because powerplant removal is unnecessary.

Ventilation Equipment

Particularly in offices attached to maintenance shops—and also in crew rooms and passenger lounges and restaurants—the problem arises of keeping the atmosphere clear of tobacco smoke and cooking odours. For this purpose **Vokes Ltd** have designed the "Renovair" smoke and airborne contaminant removal unit.

Heston Aircraft & Associated Engineers Ltd make a transportable electrically power-driven ventilation unit used in conjunction with flexible ducting to extract air from (or blow it into) enclosed spaces. One typical use is the ventilation of aircraft interiors during painting operations.

PART SEVEN
COMPANY ADDRESSES

A.F.P. Engineering Ltd, 28 Victoria Street, London SW1. T: Abbey 1657.
Access Equipment Ltd, Maylands Avenue, Hemel Hempstead, Herts. T: Boxmoor 5781.
Aerocontacts (Ground Equipment) Ltd, Gatwick Airport, Surrey. T: Horley 5511.
Air-Log Ltd, Braby House, Smithfield Street, London EC1. T: Central 2388.
Aircraft Ground Equipment Ltd, Blackswarth Road, Bristol 5. T: Bristol 54808.
Airmec Ltd, High Wycombe, Bucks. T: High Wycombe 2060.
Airmed Ltd, Harlow, Essex. T: Harlow 24331.
Airtech Ltd, Aylesbury and Thame Airport, Haddenham, Bucks. T: Haddenham 422.
Alvis Ltd, Holyhead Road, Coventry. T: Coventry 25501.
Amplivox Ltd, Beresford Avenue, Wembley, Middx. T: Wembley 8991.
Anderston Clyde Engineers Ltd, Irk Vale Works, Chadderton, Lancs. T: Main 7871.
Anticoustic Co, The, 7 Millmead, Guildford, Surrey. T: Guildford 66488.
Armstrong Whitworth Equipment, Hucclecote, Gloucester. T: Gloucester 67011.
Associated Electrical Industries Ltd, Rugby, Warwicks. T: Rugby 2121.
Associated Equipment Co Ltd, Windmill Lane, Southall, Middx. T: Southall 2300.
Atlas Copco (Great Britain) Ltd, Maylands Avenue, Hemel Hempstead, Herts. T: Boxmoor 6040.
Auto Diesels Ltd, Braby House, Smithfield Street, London EC1. T: Central 2388.
Autoset (Production) Ltd, 76 Stour Street, Birmingham 18. T: Edgbaston 1143.
Avery-Hardoll Ltd, Oakcroft Road, Chessington, Surrey. T. Elmbridge 5221.

Baxter, Woodhouse & Taylor Ltd, Woodside, Poynton, Cheshire. T: Poynton 2261.
Bell's Asbestos & Engineering Ltd, Bestobell Works, Slough, Bucks. T: Slough 25151.
Benjamin Electric Ltd, The, Brantwood Road, Tottenham, London N17. T: Tottenham 5252.
Blackburn Engines Ltd, Brough, Yorks. T: Brough 121
British Communications Corporation Ltd, Second Way, Exhibition Grounds, Wembley, Middx. T: Wembley 1212.
British Insulated Callender's Cables Ltd, Norfolk Street, London WC1. T: Temple Bar 7722.
British Oxygen Aviation Services, Pinnacle Works, Harlow, Essex. T: Harlow 26891.
Brown Construction Equipment Ltd, David, Meltham, Huddersfield, Yorks. T: Meltham 361.
Bryans Aeroquipment Ltd, 1 Willow Lane, Mitcham Junction, Surrey. T: Mitcham 5134.
Butlers Ltd, Atlantic Works, Grange Road, Small Heath, Birmingham 10. T: Victoria 3491.

C.W.C. Equipment Ltd, Kings Grove, Maidenhead, Berks. T: Maidenhead 2275.
Cementation (Muffelite) Ltd, Hersham, Walton-on-Thames, Surrey. T: Walton-on-Thames 24122.
Coates Bros Paints Ltd, Sidcup By-pass, Sidcup, Kent. T: Footscray 4451.
Cossor Radar & Electronics Ltd, The Pinnacles, Elizabeth Way, Harlow, Essex. T: Harlow 26862.
Conveyancer Fork Trucks Ltd, Liverpool Road, Warrington, Lancs. T: Warrington 35241.
Coventry Climax Engines Ltd, Widdrington Road, Coventry. T: Coventry 62607.
Creed & Co Ltd, Telegraph House, Croydon, Surrey. T: Municipal 2424.
Cullum & Co Ltd, Horace W, The Acoustic Centre, 58 Highgate West Hill, London N6. T: Fitzroy 1221.
Cullum Detuners Ltd, The Acoustic Centre, 58 Highgate West Hill, London N6. T: Fitzroy 1221.
Curran Ltd, John, Curran Road, Cardiff. T: Cardiff 20641.
Decca Radar Ltd, Decca House, 9 Albert Embankment, London SE11. T: Reliance 8111.
Dennis Bros Ltd, Guildford, Surrey. T: Guildford 5291.
Dexion Ltd, Maygrove Road, Kilburn, London NW6. T: Maida Vale 6031.
Dialled Despatches Ltd, Gosport, Hants. T: Gosport 80221.
Docker Bros, Rotton Park Street, Ladywood, Birmingham 16. T: Edgbaston 4111.
Douglas Equipment Ltd, Tewkesbury Road, Cheltenham, Glos. T: Cheltenham 56361.
Dragonair Ltd, Fitzherbert Road, Farlington, Portsmouth, Hants. T: Cosham 76451.

E.M.I. Electronics Ltd, Hayes, Middx. T: Southall 2468.
Edghill & Co Ltd, H. W., Odiham Road, Hook, Nr Basingstoke, Hants. T: Hook 40.
Elliott Bros (London) Ltd, Century Works, Lewisham, London SE13. T: Tideway 1271.
Ekco Electronics Ltd, Ekco Works, Southend-on-Sea, Essex. T: Southend 49491.
Engineering & Lighting Equipment Co Ltd, Sphere Works, Campfield Road, St Albans, Herts. T: St Albans 54524.
English Electric Co Ltd, Aircraft Equipment Division, Phoenix Works, Bradford, Yorks. T: Bradford 65221.
English Electric Valve Co Ltd, Waterhouse Lane, Chelmsford, Essex. T: Chelmsford 3491.

Fire Armour Ltd, 9 George Street, Baker Street, London W1. T: Welbeck 3313.
Firth Cleveland Instruments Ltd, Stornoway House, St James's, London SW1. T: Whitehall 2166.
Flexello Castors & Wheels Ltd, Slough, Bucks. T: 24121.
Flight Refuelling Ltd, Tarrant Rushton Airfield, Blandford, Dorset. T: Blandford 501.
Foamite Ltd, Clifton House, Euston Road, London NW1. T: Euston 5578.
Fodens Ltd, Elworth Works, Sandbach, Cheshire. T: Sandbach 644.
Ford Motor Co Ltd, Car & Truck Domestic Division, PO Box 237, Cheapside House, 135-147 Cheapside, London EC2. T: Monarch 1050.

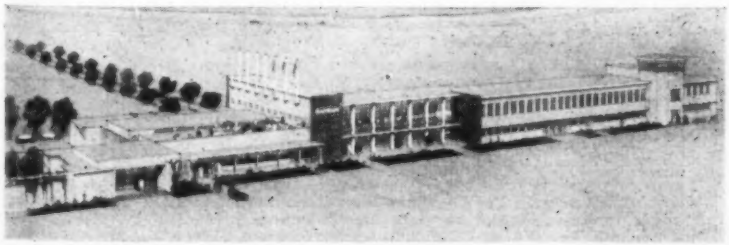
AIRPORTS AND GROUND EQUIPMENT...

Ford Motor Co Ltd, Parts Division, Aveley Depot, South Ockendon, Romford, Essex. T: South Ockendon 3434.
Fourways (Engineers) Ltd, Thornwood Common, Epping, Essex. T: Epping 2251.
Frankenstein & Sons (Mancnester) Ltd, P, Victoria Rubber Works, Newton Heath, Manchester 10. T: Failsworth 1166.
General Electric Co Ltd, Magnet House, Kingsway, London WC2. T: Temple Bar 8000.
General Fire Appliance Co Ltd, St Florian House, George Street, Croydon, Surrey. T: Croydon 2273.
Godfrey & Partners Ltd, Sir George, Hampton Road West, Hanworth, Middx. T: Feltham 3291.
Goodmans Industries Ltd, Axiom Works, Wembley, Middx. T: Wembley 1200.
Gordon & Co, Woodchester, Stroud, Glos. T: Amberley 3163.
Graseby Instruments Ltd, Kingston By-pass Road, Tolworth, Surrey. T: Elmbridge 5742.
H.M.L. (Engineering) Ltd, Harper's Yard, St John's Road, Isleworth, Middx. T: Isleworth 3011.
Harley Aircraft Landing Lamps, St Neots, Hunts. T: St Neots 230.
Heenan & Froude Ltd, Worcester Engineering Works, Worcester. T: Worcester 3461.
Heston Aircraft & Associated Engineers Ltd, Heston Airport, Houslow, Middx. T: Hayes 3844.
Holophane Ltd, Elverton Street, London SW1. T: Victoria 8062.
Houchin Ltd, Garford Works, Chart Road, Ashford, Kent. T: Ashford 1701.
I.T.D. Ltd, Webb Lane, Hall Green, Birmingham 11. T: Springfield 2282.
I.V. Pressure Controllers Ltd, 683 London Road, Isleworth, Middx. T: Isleworth 7273.
International Aeradio Ltd, 40 Park Street, London W1. T: Hyde Park 5024.
K & L Steelfounders & Engineers Ltd, Letchworth, Herts. T: Letchworth 1360.
Kidde Co Ltd, The Walter, Belvue Road, Northolt, Greenford, Middx. T: Viking 6611.
Kilfrost Ltd, Newcastle-upon-Tyne. T: Newcastle 20448.
King Aircraft Corporation, Cameron Street, Hillington, Glasgow SW2. T: Halfway 4571.
Lacre Ltd, Hatfield Road, St Albans, Herts. T: St Albans 55471.
Lansing Bagnall Ltd, Basingstoke, Hants. T: Basingstoke 1010.
Lewin Road Sweepers Ltd, Victoria Works, Hill Top, West Bromwich, Staffs. T: Wednesbury 0243.
Leyland Motors Ltd, Leyland, Lancs. T: Leyland 21400.
Leytonstone Jig & Tool Co Ltd, High Road, London E10. T: Leytonstone 5022.
M.L. Aviation Co Ltd, White Waltham Aerodrome, White Waltham, near Maidenhead, Berks. T: Littlewick Green 248.
Marconi's Wireless Telegraph Co Ltd, Chelmsford, Essex. T: Chelmsford 3221.
Matbro Ltd, Matbro Works, Horley, Surrey. T: Horley 4441.
Maurice Contractors Ltd, C, Lindsey Road, Bishop's Stortford, Herts. T: Bishop's Stortford 716.
Mercury Airfield Equipment Ltd, The Quay, Gloucester. T: Gloucester 24451.
Mercury Truck & Tractor Co Ltd, The Quay, Gloucester. T: Gloucester 24451.
Merryweather & Sons Ltd, Greenwich High Road, London SE10. T: Tideway 1016.
Miles Ltd, Alt'd, Brockworth, Glos. T: Gloucester 67011.
Modular Concrete Co Ltd, Staines Road, Bedfont, Middx. T: Ashford 5601.
Morfax Ltd, Willow Lane, Mitcham, Surrey. T: Mitcham 4525.
Morris Ltd, Herbert, Loughborough, Leics. T: Loughborough 3123.
Mullard Ltd, Mullard House, Torrington Place, London WC1. T: Langham 6633.
Munro Ltd, R. W., Bounds Green, London N11. T: Enterprise 4422.
Murex Welding Processes Ltd, Hertford Road, Waltham Cross, Herts. T: Waltham Cross 23636.
Murphy Radio Ltd, Broadwater Road, Welwyn Garden City, Herts. T: Welwyn Garden 3434.

Negretti & Zambra Ltd, 122 Regent Street, London W1. T: Regent 3406.
Normalair Ltd, West Hendford, Yeovil, Somerset. T: Yeovil 1100.
Norstel & Templewood Hawkaley Ltd, 2 Buckingham Avenue, Slough, Bucks. T: Slough 23212.

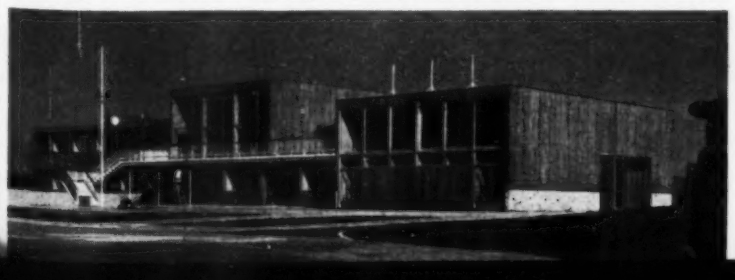
Partridge, Wilson & Co Ltd, Davenset Electrical Works, Evington Valley Road, Leicester. T: Leicester 57291.
Petbow Ltd, Sandwich, Kent. T: Sandwich 3311.
Philips Electrical Ltd, Century House, Shaftesbury Avenue, London WC2. T: Gerrard 7777.
Plessey Co Ltd, The, Vicarage Lane, Ilford, Essex. T: Ilford 3040.
Pye Telecommunications Ltd, Ditton Works, Newmarket Road, Cambridge. T: Teversham 3131.
Pyrene Co Ltd, The, 9 Grosvenor Gardens, London SW1. T: Victoria 3401.

R.F.D. Co Ltd, Godalming, Surrey. T: Godalming 1441.
Racal Engineering Ltd, Western Road, Bracknell, Berks. T: Bracknell 941.
Ransomes Sims & Jefferies Ltd, Orwell Works, Ipswich, Suffolk. T: Ipswich 54711.
Red Devon Ltd, Seymour Wharf, Totnes, South Devon. T: Totnes 3282.
Redifon Ltd, Broomhill Road, Wandsworth, London SW18. T: Vandyke 7281.
Rellumit (London) Ltd, Chandos House, Palmer Street, London SW1. T: Abbey 3304.
Research & Control Instruments Ltd, Instrument House, 207 King's Cross Road, London WC1. T: Terminus 8444.
Revo Electric Co Ltd, Tipton, Staffs. T: Tipton 2828.
Rodger, Setterington & Partners, Western Avenue, London W5. T: Perivale 7877.
Rolba Ltd, 88-92 Rochester Row, London SW1. T: Victoria 4980.



Bahrein Airport terminal buildings (architects: J. M. Wilson, H. C. Mason & Partners)

Edinburgh/Turnhouse terminal building (architects: Robert Matthew & Johnson-Marshall)



Rollason Aerocessories Ltd, Croydon Airport, Croydon, Surrey. T: Croydon 7238.
Rootes Motors Ltd, Devonshire House, Piccadilly, London W1. T: Grosvenor 3401.
Rover Gas Turbines Ltd, Meteor Works, Lode Lane, Solihull, Warwicks. T: Sheldon 4242.

Salisbury Precision Engineering Ltd, Heston Airport, Hounslow, Middx. T: Hayes 3844.
Salter & Co Ltd, Geo, High Street, West Bromwich, Staffs T: West Bromwich 1855.
Saro (Anglesey) Ltd, Beaumaris, Anglesey, North Wales. T: Beaumaris 130.
Searle Ltd, R. J., Sunbury, Middx. T: Sunbury 3014.
Short & Mason Ltd, Aneroid Works, 280 Wood Street, Walthamstow, London E17. T: Coppermill 2203.
Siebe, Gorman & Co Ltd, Neptune Works, Davis Road, Chessington, Surrey. T: Elmbridge 5900.
Simmonds Aerocessories Ltd, Treforest, Pontypridd, Glam. T: Treforest 2211.
Simon Engineering (Midlands) Ltd, Queen's Cross, Dudley, Worcs. T: Dudley 54661.
Simon Equipment Ltd, 48 George Street, Portman Square, London W1. T: Welbeck 2371.
Skyhi Ltd, Pulsometer House, 20-26 Lamb's Conduit Street, London WC1. T: Holborn 1402.
Spurlings Ltd, Rookery Way, The Hyde, Hendon, London NW9. T: Colindale 7171.
Standard Telephones & Cables Ltd, Connaught House, 63 Aldwych, London WC2. T: Holborn 8765.
Steel Barrel Co Ltd, The, Uxbridge, Middx. T: Uxbridge 8535.
Steels Engineering Products Ltd, Sunderland Co Durham. T: Sunderland 56281.
Stockport Manufacturing Co (1950) Ltd, Councillor Lane, Cheadle, Cheshire. T: Gatley 4205.
Stone-Chance Ltd, Gatwick Road, Crawley, Sussex. T: Crawley 25251.
Stratton & Co Ltd, Eddystone Works, Alvechurch Road, West Heath, Birmingham. T: Priory 2231.
Stream-Line Filters Ltd, Henley Park, Normandy, near Guildford, Surrey. T: Normandy 3311.
Sun Engineering (Richmond) Ltd, The, 45-49 Cambridge Road, Kingston-on-Thames, Surrey. T: Kingston 7407.

Tannoy Ltd, 348 Norwood Road, West Norwood, London SE27. T: Gipsy Hill 1131.
Taylor (Metal Workers) Ltd, C. F., Molly Millars Lane, Wokingham, Berks. T: Wokingham 1005.
Tecalemit Ltd, Plymouth, Devon. T: Plymouth 62844.
Thames Packaging Equipment Co, The, 28 City Road, London EC1. T: Monarch 7387.
Thermionic Products (Electronics) Ltd, Shore Road, Hythe, Southampton. T: Hythe 3265.
Thompson Bros (Bilston) Ltd, Bradley Engineering Works, Bilston, Staffs. T: Bilston 41264.
Thorn Electrical Industries Ltd, Great Cambridge Road, Enfield, Middx. T: Enfield 5353.
Tiltman Langley Ltd, Redhill Aerodrome, Surrey. T: Nutfield Ridge 2232.
Transport Equipment (Thornycroft) Ltd, Basingstoke, Hants. T: Basingstoke 1200.
Truro Engine Works Ltd, Morden Road, London SW19. T: Cherrywood 3361.

Ultra Electronics Ltd, Western Avenue, Acton, London W3. T: Acorn 3434.

Vernons Industries Ltd, Kirkby Industrial Estate, Liverpool. T: Simonswood 3261.
Vokes Ltd, Henley Park, Guildford, Surrey. T: Guildford 62861.

W.S. Electronics Ltd, 44 Brunel Road, East Acton, London W3. T: Shepherds Bush 0333.
Wayne Tank & Pump Co Ltd, Western Road, Bracknell, Berks. T: Bracknell 1600.
Wessex Industries (Poole) Ltd, Dolphin Works, West Street, Poole, Dorset. T: Poole 2000.
Westinghouse Brake & Signal Co Ltd, 82 York Way, King's Cross, London N1. T: Terminus 6432.
Westrex Co Ltd, Liberty House, Regent Street, London W1. T: Regent 1001.
Witco Chemical Co Ltd, Bush House, Aldwych, London WC2. T: Temple Bar 6473.

Zwicky Ltd, Buckingham Avenue, Trading Estate, Slough, Bucks. T: Slough 21201.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Fuel Duel

WHAT a great disservice to civil aviation it was—on the part of Lord Brabazon and the BBC—to devote time in *Panorama* to the relative merits of JP.1 and JP.4 jet fuel.

Very rightly, this subject has been receiving attention in the aviation journals; but surely nothing but harm can come to the industry as a whole by an argument which commences "When an airliner crashes"! It was unfortunate that Lord Brabazon's claims were not answered by fuel technologists—and even more unfortunate that millions of viewers were led to associate sheets of flame with day-to-day air travel.

When we consider that today the bulk of the world's airline passengers still fly in piston-engined aircraft using petroleum —the most inflammable of all fuels—nothing can be said for creating a situation which appears calculated to undermine the public's confidence in the safety of civil flying.

London W1 PETER COLBOURNE

Bicycles and the Board

I WAS interested by your editorial comment [*Bicycles and the Board*, November 25] on my suggestion in *The Times*. I agree that it is essential that the economic factors should be fully evaluated, but I suspect that BEA, owing to its high cost levels, would be able to show that it cannot afford substantially lower load factors on the domestic trunk routes.

My suggestion of intermediate stops on these services is aimed at providing an extra source of traffic for independent operators primarily serving provincial centres such as Liverpool, Leeds and Newcastle. The relief ot congestion on BEA services is a valuable by-product and should provide an important stimulus, as a first step towards free competition. The history of Capital Airlines' service on the route Chicago - Washington provides an interesting parallel.

Newport, Mon F. G. REES

RAF Winners of the George Cross

FOR many months I have been collecting information in the hope of compiling a book on the RAF/RCAF winners of the George Cross, and have unearthed the epic (and, I believe, unpublished) account of the death of Wg Cdr Noel Dowland, GC, whilst commanding No 69 Squadron at Luqa, Malta, on January 13, 1942.

Gp Capt C. H. Cahill, DFC, AFC, who commanded Luqa at the time, tells me that the action in which Dowland lost his life "remains one of the most memorable events of my service." Other eye-witnesses state, "This was the best air fight ever put up over Malta," etc.

No posthumous award was made for Wg Cdr Dowland's service with No 69 Sqn, though the evidence seems to indicate that it is time a long-standing wrong was put right. Would any reader able to add anything to my information, or be in a position to give me the address of Dowland's navigator—Fg Off Potter—who alone survived, kindly communicate with me as soon as possible?

90 Woodside, Leigh-on-Sea, Essex LESLIE HUNT

Bacon Grilled

I AM glad to see that your Mr Bacon has got himself thoroughly roasted for his half-baked "nitpickers" paragraph: the most charitable explanation of his writing such utter gammon is that he either didn't see the programmes at all or was too stewed to notice the many colossal clangers. I realize that in order to hog the limelight a columnist has to be rasher than more serious writers and the quality of his output is bound to be streaky; but this piece was particularly ham-fisted and amply deserved the grilling which your correspondents have given him.

Potters Bar, Mddx A. FRYER

ROGER BACON's ideas on accuracy seem to be on par with my own views on typing—if it puts over the essential point, then that is all that matters (when I do it myself!)

Surely the Technical Editor could have told him that the missiles portrayed on page 848, November 25, were tactical types and not surface-to-air, as quoted? Could it be that R.B. has not persuaded you to buy his Secrecy Revealer System? Or could I possibly sell the firm my own ICBM? (Inter-Communications Bearer of Missives). Perhaps a Terrier (Typing Errors Reading Reappraisal Ink-Erasing and Rewriting unit) might be in order?

I hope this dig (which, in view of the controversy recently raging, was irresistible) will be forgiven, as I am a firm fan of "Straight and Level" in my more serious moments—or, should I say, lucid intervals?

Brynsiencyn, Anglesey FREDERIC K. JONES

[Bacon has taken the Terrier out for some brisk exercise.—Ed.]

Read, Mark and Learn

YOUR writer Mark Lambert, in his article *Jet Speedbird West and East* in the issue of November 25, 1960, appears to be in some doubt as to where "Cillard" RAF radar is. Maybe if he had studied the article *Military Air Traffic over Britain* (System Survey, *Flight*, August 19, 1960, page 275) he might have guessed that the radar referred to is at RAF Bishop's Court, Co Down. Undoubtedly, then, the call-sign is "Killard," as the radar is built on Killard Point. Congratulations, though, on another excellent up-to-the-minute piece of writing of the high standard which *Flight* readers always enjoy.

Belfast 5 ROY WILSON

[Mark Lambert—who wrote *Military Air Traffic over Britain*—comments: "The RAF referred always to Bishop's Court, but the BOAC crew thought Killard was possibly in Scotland. There was not time before going to press to confirm what we only suspected."—Ed.]

THE INDUSTRY

Smiths' Big Contract

THE 1959-60 report of S. Smith & Sons (England) Ltd, issued in connection with the a.g.m. taking place last Wednesday, mentions, *inter alia*, the progress made with aviation products. It is stated that the new series of autopilots and associated equipment resulting from development work during the past five years are to be fitted to RAF Transport Command aircraft and to the de Havilland Tridents for BEA. In connection with this work the company have received the largest development contract ever placed with them by the Government. [Smiths are supplying the SEP.4 autopilot for Bomber Command and the SEP.5 for the Trident and Britannic.]

Searching for Knowledge

DRAWING a text from his own experiences, the ornithologist and TV personality Mr Peter Scott told Smiths Aviation Division apprentices at Cheltenham on November 23 how important a "broad search for knowledge" was, if their future lives were going to enable them to accept every opportunity which might be offered. Mr Scott, who was presenting annual awards at the company's training school, commented on aspects of his research into the homing instincts of wild geese and said that his own interests had led him into gliding and sailing as well as to exploration.

The chair was taken by Mr Leonard Morgan, director and general manager of Smiths Aviation Division, who referred to a comment made by the Duke of Edinburgh during a recent visit to the Cheltenham factory—that "a right and properly organized apprenticeship scheme could provide every apprentice with a chairman's pen in his tool kit." Reporting on this year's apprentice results, the division's education and training executive, Mr A. Hirst, said there had been an all-round improvement—to which the company's improved selection methods had no doubt contributed.

As from January 2 Wakefield-Dick Industrial Oils Ltd, a member of the Castrol Group, will be renamed Castrol Industrial Ltd.

Two appointments on the British Aircraft Corporation publicity staff have been announced. Mr C. G. Hollowell, formerly deputy publicity manager of the English Electric Co Ltd, has been made BAC advertising manager; and Mr Bryan Moon, previously with the publicity department of the London office of Vickers Ltd, has become assistant advertising manager.

A new catalogue describing the range of Dagenite civil and military aircraft batteries has been published by Pritchett & Gold and E.P.S. Co Ltd, Dagenite Works, Dagenham Dock, Essex. It includes detailed descriptions of the latest 74V range for the D.H. Trident and Comet, Vickers VC10, Vanguard and Viscount, Handley Page Herald and Fokker Friendship. A special section is devoted to ground-starter batteries.

Announcing the retirement of Mr Peter H. Redpath on December 31 as vice-president, sales, of Canadair Ltd, the company say: "His record throughout his long career in aviation is a proud one and Canadair is happy to retain his services as a consultant for an indefinite period." Mr Redpath has been with the company since 1950. Other Canadair news is that Mr John C. Winterburgh has been appointed European representative (having successively been assistant and acting representative) of Canadair Services Ltd. His headquarters will continue to be at Princes House, 190 Piccadilly, London W1.

Akrotiri's new air traffic control tower being looked at closely by a Vulcan of No 617 Sqn, flown by the squadron commander, Wg Cdr L. G. A. Bastard. The tower, at the RAF's main base in Cyprus, was opened during October

SERVICE AVIATION

Royal Air Force, Naval and Army Flying News

Indian CAS Appointment

A GRADUATE of the Imperial Defence College and of the RAF College, Cranwell, Air Marshal A. M. Engineer has been appointed Chief of the Indian Air Staff: he succeeds the late Air Marshal S. Mukerjee, who died suddenly last month. The new CAS, who is 48, has until recently been managing director of the Hindustan Aircraft factory at Bangalore. He won the DFC in the Second World War and in 1930 became the first Indian to fly between England and India.

RCAF Senior Post

FOLLOWING the retirement of AVM J. G. Bryans as AOC Training Command, RCAF, the appointment of AVM H. M. Carscallen to the post has been announced. AVM Bryans, who is 54, has headed the Command since 1955 and retired on December 1. His successor, who is 51, has been Chief Staff Officer at 4th Allied Tactical Air Force headquarters, Ramstein, Germany, since 1956. During the war AVM Carscallen served with No 424 Sqn on bomber operations and was awarded the DFC.

Far East Defence

SPEAKING at RAAF Amberley on his arrival for an official visit to Australia the C-in-C FEAF, Air Marshal A. D. Selway, said that guided missiles—probably either Bloodhounds or Thunderbirds—would be sent to Singapore soon to help to strengthen its defences. He also said his command would get new aircraft, including Hunters and Javelins. The recently completed 9,000ft runway at RAF Tengah on Singapore Island would take any bomber now in service, but Singapore could easily be defended with guided missiles. There was no need to station V-bombers in the Far East. It was better to have them in Britain; they could get out to the Far East in a very short time if needed.

Congo Airlift

SOME figures about the airlift of Ghanaian troops and equipment from Accra to Leopoldville (as part of the UN emergency force) in aircraft of Transport Command were given by the Secretary of State for Air, Mr Julian Amery, in the Commons on November 30. He said that up to November 25 about 2,500 passengers, 300,000lb of freight and 6,000lb of mail had been moved from Ghana to the Congo. Thirteen different aircraft had been employed. Since the initial lift, however, not more than two aircraft had normally been used at any one time.

Air Cdre A. G. Dudgeon, Commandant of the Air Training Corps, presenting the Sir Alan Lees Efficiency Trophy to Sqn Ldr R. Kenworthy (right), CO of No 1855 (Royton) Sqn of the ATC

Paris to Nairobi

A DISTINCTION which the new Senior RAF Officer East Africa, Gp Capt J. C. Macdonald, can claim is that of having participated in No 102 Squadron's first operational flight of the Second World War—as captain of a Whitley dropping propaganda leaflets over the Ruhr on the night of September 4, 1939. He went on to win the DFC in June 1940, when commanding No 77 Sqn; the AFC in 1942; and a Bar to his DFC when in command of No 15 Sqn. He is also a CBE.

Gp Capt Macdonald, who has the acting rank of air commodore in his new post (which he takes up in Nairobi in mid-December), has been until recently the United Kingdom Military Representative at SHAPE.

IN BRIEF

The Air Minister, Mr Julian Amery, visited Fighter Command headquarters last Friday. He was received by the AOC-in-C, Air Marshal Sir Hector McGregor, and given a briefing on the Command's role and capability. On November 29, Mr Amery visited the Bomber Command stations Waddington and Hemswell.

COs of RCAF auxiliary units recently met in Ottawa to discuss the role of the auxiliaries within the overall structure of the RCAF.

The RAF Benevolent Fund spent £381,918 in Britain and overseas during the first nine months of this year, making a total of 8,876 awards.

RAF Bicester, Maintenance Command, have won the Jolliffe Trophy, awarded annually for the most attractive and efficiently run airmen's dining-hall on a home Royal Air Force station.

A reunion and disbandment dinner was held by No 20 Sqn in London recently. At present based at Gutersloh, in Germany, equipped with Hunter F.6s, the squadron is to cease operations at the end of this year.

HMS *Aeriel II*, the RN air station at Worthy Down near Winchester, became the headquarters of the Royal Army Pay Corps last week after being a flying station for the past 40 years.

A 49-year-old MT fitter, Bahal Ahmed Nassir, longest-serving Arab employee at RAF Khormaksar, was taken on a training flight in a Meteor recently by the station commander, Gp Capt John Merifield.

In answer to a question about what use was now being made of RAF Mona in Anglesey, the Under-Secretary of State for Air, Mr W. J. Taylor, said in the Commons recently that it was being increasingly employed as a relief landing ground for aircraft operating from RAF Valley.

The fifth of a number of underground headquarters for the Royal Observer Corps is being opened tomorrow (December 10) by the Earl of Ancaster, Lord Lieutenant of Lincolnshire. Situated at Fiskerton, near Lincoln, it is for use by No 15 Group of the ROC.

The Secretary of State for War, Mr John Profumo, gave some information recently about helicopters on BAOR strength. He said that half were operational, half at present undergoing servicing. He admitted that there had been troubles with the helicopters [Skeeters], but none were now grounded.

Viscount Ward of Witley (right), who retired recently as Secretary of State for Air, at a dinner given in his honour by senior RAF officers at Fighter Command HQ. With him is Air Chief Marshal the Earl of Bandon, who until June commanded the Far East Air Force

Left, a Rolls-Royce Avon goes aboard a Derby Aviation DC-3 at Derby Airport, one of 100 of these Caravelle engines delivered so far by this independent to the Sud Aviation factory at Toulouse, to Copenhagen, Stockholm and Algeria. Derby Aviation's contract for the air freighting of Avon engines from Burnaston resulted from the granting earlier this year of customs permission to export freight from Derby Airport. Right, a Tradair Viking unloads at Southend two hogsheads of port—the first to be imported from Portugal by air. Flooding over there has made shipping impossible. Third from left, Mr Henry Porter of Tradair watches the port being imported

AIR COMMERCE

JOHN BRANCKER'S NEW JOB

THE formation is announced of a new company, Consultair, in Montreal. It is to be directed by Mr John W. S. Brancker, who was traffic director of IATA until his controversial resignation last July. Consultair will provide consulting and advisory services in the fields of aviation, tourist promotion and traffic development. The address is 4870 Cotes des Neiges Road, Montreal, Canada.

Mr Brancker was one of the first batch of Imperial Airways apprentices 30 years ago. He has served with Imperial Airways, BEA and BOAC in the UK, North America, Europe, Africa and the Middle East. Before he joined IATA in 1953 he was general manager, international affairs, for BOAC, and he represented that airline at the IATA traffic conferences. Mr Brancker has also been vice-president of the Institute of Transport and member of the board of the British Travel and Holidays Association.

BOAC TO LOS ANGELES

LOS ANGELES is to be added for the first time to the BOAC network on March 2, when Boeing 707s are to begin a non-stop service between London and the USA's second largest city. The service will operate twice-weekly in each direction, increasing to three times a week during the peak summer season. Eastbound the 5,443 miles will be covered in 11hr; westbound 14hr.

BOAC have always been eligible, under the air agreement with the USA, to operate into Los Angeles, and the corporation received the necessary US foreign carrier permit last April. The route has not been operated hitherto largely owing to lack of capacity.

As reported in *Flight* for May 20, there is a body of opinion in BOAC which considers that the route makes economic nonsense, the only case for doing it being that other airlines like SAS, TWA, PanAm and Air France would drain West Coast and European business off the North Atlantic route. But BOAC is expecting to generate about £800,000 worth of revenue in Los Angeles in the coming year, revenue which might otherwise have been drained off by competitors offering the "non-stop Polar route" connection to Europe—which in practice is anything but polar and which more often than not requires a fuelling stop on the US eastern seaboard. BOAC do not mention the word polar in their announcement.

Initially the 707s will seat 32 first-class and 97 economy class passengers; but during the peak summer period there will be more emphasis on the economy class, the ratio being 24F : 111E. BOAC say that the new service is expected to be of particular interest to businessmen, as Los Angeles is the fastest growing major industrial centre in the USA, with its 6,500,000 population having increased by 50 per cent in the last ten years.

This news is further evidence of the tremendous effort that BOAC are putting into western routes, which now account for more than half the corporation's output, and which over the past year has been increasing month by month by percentages of the order of 30 or more.

WESTLAND 192Cs FOR BEA

THOUGH no statement has yet been published, BEA has reportedly decided on its helicopter—the choice having for a year or more been between the Vertol V.107 or S-61 on the one (US) hand, and the Westland (Bristol) 192C on the other (British) hand. The choice is to be the 10-15-seat 192C, commercial version of the RAF's Belvedere. Delivery date is not known but an initial two may be available as early as the 1961-62 delivery date expected of the Sikorsky S-61 and the Vertol V.107.

It will be recalled that BEA asked the Minister of Aviation for a subsidy—£45,000 a year for three years—for the operation of interim scheduled helicopter services, probably initially on the Lands End - Scillies route, with either the 192C, the S-61 or the V.107. The Minister is said to have granted BEA a development subsidy on condition that the British helicopter was ordered. According to present plans BEA will have two 192Cs.

What helicopter next? BEA's lack of enthusiasm for the Rotodyne is barely concealed, and it is evident that their interest now centres on the Westland (Bristol) 194, the quieter 50-seat development of the 192C which should become available in 1963.

DIFFICULTIES OF THE "NON-BIATAs"

IN the last few weeks five of Britain's small independent operators have either fallen by the wayside or have ceased operation.

Continental Air Transport, which was started a year ago, is reported to owe Southend Corporation about £13,000 in airport fees, and is said to be in voluntary liquidation for debts amounting to more than £200,000. Continental is also said to owe two petrol companies £54,000. According to one report, the Southend council has asked its airport committee to find out why the company was allowed to accumulate such a debt. The managing director, Capt Ian McLean, says the company [which owned a DC-4 and two Vikings] failed because of unserviceable aircraft. It carried 40,000 passengers during the season, but had to off-load other bookings to other companies at a loss owing to unserviceability.

Falcon Airways, the airline which Capt M. Kozubski formed after the liquidation of Independent and its successor Blue Air, also now appears to have ceased operation. The acquisition of its assets by Air Safaris—which a fortnight ago acquired **Don Everall**—has been reported in the previous two issues of *Flight*. However, last week Capt Kozubski said that, depending upon the Board of Trade granting an import licence, two Constellations are to be purchased from Capital and an option has been taken on a third. Falcon hope to start operating from Gatwick in January.

Air Condor, which has operated from Southend Airport, is in

AWA are working overtime at Coventry on the completion of the Riddle Airline's order for seven Argosies, reported in last week's issue. Here is the third aircraft in the Coventry factory; delivery of the first was imminent as this issue appeared. A further note appears below

the hands of a receiver. The chairman and managing director, Mr William Royston Lea, denies that the company is in liquidation but says that its aircraft (during the season Air Condor operated two Bristol Freighters and a Viking) have been temporarily grounded.

Orion, which operates three Vikings from Gatwick, also has ceased operations.

These events, and other similar closures that may well occur during the next few months, are the result of the tighter control of British civil aviation enacted by the Civil Aviation Licensing Act. This requires not only that all operators shall have an air operator's certificate, to be issued by the Ministry's safety authorities, but also that much of the charter business on which the small companies thrived shall now be licensed.

The four companies whose demise is recorded are all "non BIATA"; it remains to be seen whether any members of the British Independent Air Transport Association will find themselves in distress as a result of the new law. Of the eleven non-BIATA operators listed on page 758 of *Flight* for November 11, only six now still remain in business. These are: Air Safaris, Maitland Drewery, North-South, Overseas, Pegasus and Tradair.

Stop Press: To be formed by Mr Henry Corsellis is a new airline called Titan Airways. It may be staffed by personnel from Continental, Air Condor and Orion, and first equipment will be two Vikings. Mr Corsellis has previously been with Independent Air Travel, Blue Air and Continental Air Transport.

OVERTIME ON THE ARGOSY

FIRST of the seven Argosies ordered by Riddle is due to be delivered as this issue appears, and the seventh will be on its way by April. To meet this schedule everyone at AWA involved in the programme, from fitters to flight test-crews, are (reports a correspondent recently at AWA) working full out; both the production and test flying facilities are kept open well into the night and over the weekends where necessary.

The poor weather conditions of the past few months, combined with the short daylight hours, could have seriously hampered the test programme and delayed the schedule. No. 1 aircraft had to complete 30 hours, and this has involved night flying.

SAS "IMPERIALISM" IN GERMANY

AN unusually frank statement is forthcoming from Lufthansa about the disagreement between the German airline and SAS over traffic rights. Negotiations have been broken off once more, and Lufthansa refer to "imperialism of air traffic."

They say that a SAS statement to the Press on October 20, to the effect that SAS has become the scapegoat of German air traffic policy, is "incomprehensible." Lufthansa "strove again and again to reach an understanding . . . with unending patience." SAS was not willing to agree to services with Lufthansa on a footing of equality "which, what is more, was only proposed to come into effect in 1964." SAS refused to come to an agreement "such as is usual in air traffic between two neighbouring European countries, and such as has been introduced between West Germany on the one hand and Great Britain, France, Spain, Italy and Austria."

Lufthansa suggest that SAS intended to make use of traffic rights in a way that would use the services to and from neighbouring countries as "vacuum cleaner routes" [i.e. feeders] for their international services. It cannot, the Germans say, be demanded of a Scandinavian traveller from Central Europe "that he should be dependent on air connections to Copenhagen, Oslo and Stockholm which, so far as their timing is concerned, pay no attention whatsoever to his needs as a businessman and tourist, simply because they are primarily intended to provide connections to the intercontinental services of SAS."

The German airline says that SAS's insistence is "even more incomprehensible," since such exceptional circumstances in no way exist between Scandinavian countries and Great Britain, France and Italy. It is noted that SAS operates 49 services to airports within West Germany as compared with some 18 to Great Britain, seven to France and nine to Italy. Lufthansa is of the opinion that "an excess of transport capacity such as SAS has, as a result of lack of a sufficient Scandinavian traffic potential of its own, should not pave the way for imperialism of air traffic." With the same rights which SAS claims today, "of holding a position in the air traffic market of the Federal Republic not only over that of all the other foreign airlines operating here, but also over that of the national airline Lufthansa itself, the Swedish Railways could demand to be allowed to take over part of the Federal Railways."

Lufthansa says it is striving for "nothing more than an adjustment of the competitive situation in Germany according to international norms."

BRITAIN'S INSOLVENT AIRPORTS

IN a letter to *The Times* last week Mr J. V. Hose of Business Aviation refers to London Airport as "outrageously restrictive. In spite of the fact that the qualified private flier is crying out to use the airport," he says, "the Ministry's administrators do everything possible to discourage their business." It was shown in *Flight* last week that aircraft movement figures in the London area have actually declined—presumably because of fewer movements by general aviation aircraft.

RAeS ALL-DAY SUPERSONIC SESSION

ALL day yesterday, December 8, the new lecture theatre of the Royal Aeronautical Society was due to be the focal point of a detailed discussion of supersonic transport aircraft. This will be recorded in these pages in due course: in the meantime an advance synopsis of some of the contributions is summarized.

The assistant chief engineer of Bristol Aircraft, Mr M. G. Wilde:—

"The arguments in favour of selecting a cruising speed of about M2 for long-range supersonic transport aircraft have been given by Mr Morgan [BEA]. Kuchemann has demonstrated that slender wing shapes provide the basis for the layout of the aircraft and has given the general properties which would lead to the achievement of optimum cruising lift-drag ratios.

"This paper shows that the layout chosen for best cruising efficiency alone does not give the lightest aircraft for the duty if the influence of off-design performance and component weights is taken into account. It is suggested that layouts having reduced wing area and increased span to length ratio would be superior.

"Trends in this direction yield aircraft shapes having a high percentage of their total volume contained within the fuselage. It may then be possible to produce a favourable interference force between the wing and fuselage flow fields and so to improve the lift-drag ratios assumed in the derivation of these shapes."

Mr R. C. Morgan of BEA discussed the systems-engineering aspects of supersonic transports:—

"We may question the statements that a totally new standard of systems engineering is necessary for the supersonic as distinct from subsonic aircraft. Arguments as to the importance to economy of factors like high utilization and short turn-rounds are surely equally applicable to both types of aircraft. The special needs for reliability of systems is in fact less likely to stem from these factors than from the increasing dependence (for safety) of the supersonic aircraft on certain systems, e.g. cabin air conditioning at very high speeds and altitudes, or variable geometry for the structure. Despite the attentions that will be paid to reliability of systems on the complex supersonic—and subsonic—aircraft of coming generations, it is likely that we shall continue to rely on system muliplication of one sort or another for safety.

"Given multiplex systems then, and given that airlines must continue to rely on component change rather than an on-the-spot breakdown of equipment for rectification, our attentions on both supersonic and subsonic aircraft will be increasingly directed to fault-diagnosis equipment, which will direct us to the faulty removable component. An essential requirement is that facilities for test equipment, superimposed on a multiplex system, do not interfere with the functional independence of the parts of such a system."

Other contributors included Mr David James, chief structural engineer of Vickers; Dr N. J. L. Megson, MoA; Mr H. Pearson, Rolls-Royce; Mr A. V. N. Reed, Bristol Siddeley; Mr P. L. Sutcliffe, Hawker Siddeley advance projects group; Mr D. M. Jameson, ARB; Capt F. Ormonroyd, BEA; and Mr C. H. Jackson, BOAC.

Goodbye G-ALBO: Right, on November 30, 1960, the Bristol Britannia 100 prototype G-ALBO, Godfrey Auty up, took off from Filton on its last flight—to RAF St Athan, where it will be used for ground instruction. Above, flash-back to G-ALBO's maiden flight (Bill Pegg) on August 16, 1952

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ABOUT THOSE FORMS

QUESTIONED in the House about the proposed air travel forms to be introduced by the Government, the Minister of Aviation, Mr Peter Thorneycroft, said last week that the considerations were "in some sense hypothetical, because until the Order in Council is made there is no such scheme. Until I have to deal with that scheme," he said, "I am not really so bothered about the difficulties of putting it into operation."

Pressed to say whether the Minister and the Government consider that such a scheme is necessary at all, Mr Thorneycroft sidestepped by saying: "The necessity for the scheme is not a matter for my department. If it was introduced some discussions would take place, but the broad view as I understand it is that the airlines do not like it."

Sir Arthur Vere Harvey (Con, Macclesfield) asked the Minister to bear in mind that a few years ago when passengers had to fill in forms showing where they had spent the last 14 nights "they gave ridiculous answers." Mr Thorneycroft: "I will certainly call the views of my hon and gallant Friend to the attention of my right hon Friend."

NOISE ON THE APPROACH

AIRCRAFT landing at London Airport are to be placed under a radar watch to check that they do not come in too low. This monitoring will be carried out in good weather by Approach Control or by precision radar and is intended to allay public concern about the height at which aircraft have been approaching to land.

In a letter from the Director of Control and Navigation (Operations) of the Ministry of Aviation to the London Airport Standing Consultative Committee, it is said that the "increasing size of modern aircraft tends to make them seem lower than they really are. Radar surveys carried out from time to time show that pilots do not, in general, fly lower than they should. However, the Ministry considers that regular checking of aircraft heights in good weather will also do much to allay concern about low flying . . . In future we shall be monitoring a number of approaches each week selected when operational conditions permit. No instructions will be passed to the pilots on these occasions nor warning given that a particular approach is being monitored. Unduly low approaches will be logged and any particular cases taken up with the airlines concerned."

BEA - OLYMPIC PUZZLE

WHEN asked in the Commons earlier this year to state the terms on which Comets are being supplied by BEA to Olympic Airways, the Parliamentary Secretary to the Ministry of Aviation, Mr Geoffrey Rippon, replied that it would be "contrary to normal practice to disclose the terms of this contract." Sir Arthur Vere Harvey, who was questioning him, wanted to know why there was so much secrecy about what should be a normal commercial matter. Mr Rippon replied: "This is a normal commercial matter. The arrangement is part of a commercial agreement between BEA and Olympic. It would be in neither BEA's nor in the national interest to publish details of such matters." Not satisfied, Sir Arthur Vere Harvey declared that "an operating industry like BEA is not there to sell aircraft on the hire-purchase system."

Shortly afterwards the *British Register* included three Comet 4Bs, additional to the fleet of seven at that time ordered by BEA, with British registrations. They were intended, a BEA spokesman confirmed, for Olympic Airways.

Last September at Copenhagen Mr George N. Emmanuel, deputy managing director of Olympic Airways, was asked whether he knew of the suggestions that BEA were financing his airline's Comets. He replied that, so far as he was aware, these aircraft [of which four have now been ordered] were being "entirely financed" by Olympic Airways.

The Ministry say that this is "a normal commercial matter," but a note in *Public Investment in Great Britain*, recently presented to Parliament by the Chancellor of the Exchequer, refers to the purchase of ten BEA Comet 4Bs [last week increased to 14] as *including* the aircraft for Olympic Airways. "Public Investment in Great Britain," as the document is entitled, appears to include also public investment in Mr Aristotle Onassis's airline.

POOLS ON THE TABLE

MEMBERS of the Indian Parliament appear to be more interested in airline pool agreements than MPs in this country. In the Lok Sabha recently the Deputy Minister for Civil Aviation, Dr Subbaroyan, was asked by a member to place a copy of the Air-India/Qantas/BOAC pool agreement on the table of the House. Dr Subbaroyan replied that the agreement had been entered into by three autonomous corporations, and the foreign partners might not like the information published.

The Deputy Speaker, Mr Hukam Singh, ruled that Parliament was entitled to know how the agreement affected Air-India, and he saw no objection to the placing of the relevant portion of the agreement concerning the distribution of profits on the table of the House. He said he would discuss the matter with the Minister and see what could be done. "I am sure," he said, "that the information must be supplied to members."

So far none of BOAC's or BEA's pool agreements has ever been the subject of questioning at Westminster. At the recent review in Bombay of the Air-India/Qantas/BOAC tripartite agreement, Mr B. W. Bampfylde, BOAC's eastern routes manager, said that the pool agreement is working "smoothly" and that it has benefited "all concerned." He said that it was not the practice in Britain to publish commercial agreements. He pointed out that if BOAC had any doubts of the working of the agreement they would not have entered into such an agreement, "and I am sure the same goes for Air-India International. Now that Air-India is extending its European network to the United States," he said, "it is bound to help them considerably."

WHAT PRICE USED AIRLINERS?

WHO will buy used airliners, and how much are they selling for? The best buys in a market that still favours the buyer more than the seller could be the big Douglas and Lockheed piston transports, which can be converted from passenger to all-freight use. According to the current list of one well-known London dealer, W. S. Shackleton, a typical DC-7/7B price is £340,000-£360,000, a price that has not dropped since *Flight*'s last survey of the used aircraft market last year (August 21, 1959).

Other prices are £160,000 for a 1953 DC-6B, with a 1951 model

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going for slightly less; both would appear to be good value for this popular transport, examples of which have been selling in the £200,000 range. Another DC-6B is going for £240,000 less £3 10s ($10) per aircraft hour and £5 10s ($15) per engine hour since overhaul.

There are nine members of the DC-4 family—C-54s or actual DC-4s—available, a typical price for a C-54A being £53,595 "as is," or £75,000 with complete overhaul. Another is going for £64,300 for immediate delivery. Four DC-4s are available in the USA priced at from £70,000 to £85,000, closely conforming with the price established by *Flight's* analysis of the Aircraft Exchange figures in August 1959.

Half a dozen DC-3s are available at London Airport at prices between £17,000 and £18,000, with another available in the UK for no more than £13,000. These figures are 40 or 50 per cent below those averaged out from Aircraft Exchange reports more than a year ago, when good DC-3s were available for about £25,000.

One of Cubana's Viscount 700Ds is going for £285,000, whilst another 700 model is available in the UK for no more than £145,000, and a Viscount 810 is available in North America for £365,000.

UNWILLINGLY TO GATWICK

LORD DOUGLAS said at BEA's annual news conference last September that the corporation would move to Gatwick provided foreign airlines could be persuaded to do the same. He added—and his chief executive Mr A. H. Milward emphasized the point—that the corporation had spent £12 million on its base at London Airport.

Now the Minister of Aviation, Mr Peter Thorneycroft, tells Parliament that he has asked Air France to move some of its London - Paris services to Gatwick next April 1, as BEA are proposing to do. The French airline has been pressed behind the scenes to move some of its operations to Gatwick for a year or more, and has always raised objections. Now these objections have come out into the open. The airline says that it will "strongly resent being made to use Gatwick Airport, owing to its distance from London." Passengers coming from France to London on a Caravelle in 45min would, they say, "take from two to two-and-a-half hours to reach their hotels in London." Furthermore, passengers coming from Paris to Gatwick would be unable to make connections with BEA services to the UK provinces.

Though traffic at Gatwick has increased during 1960 compared with the previous year, the airport is still seriously under-utilized. BEA, for example, are scheduling only two daily movements there this winter. Just as pressing is the problem of congestion at London Airport Central, and other airlines being asked to transfer some services to Gatwick are Swissair, Alitalia, Iberia and TAP.

The third and last de Havilland Comet 4C for Mexicana left Hatfield for Mexico City (via Gander and Chicago) on November 29. Seen boarding are, r to l, Mr H. G. Sturgeon, managing director, D.H. aircraft; Mr E. A. Rovzar, Mexicana's director of public relations; and Mr P. D. Irons, D.H. financial director. Mr Sturgeon and Mr Irons are visiting Latin America where, say D.H., there are prospects of further Comet 4 sales

VEB.152's DESIGNER GOES WEST

THE troubles in the East German aircraft industry were highlighted last week when Herr Fritz Freytag, joint designer of the VEB.152, sought refuge in West Germany. He is chief designer of the East German aircraft industry, and technical director of the state-owned aircraft factory at Dresden.

The prototype VEB.152, which he designed with Professor Brunolf Baade, crashed last year on a test flight. Since then three others have been tested, but Herr Freytag is reported to have said that test flights were suspended last September until next April.

BEA's IMAGE IN THE USSR

AT the British Trade Fair in Moscow next May BEA will tell its story to the Russians, says the corporation, "in no uncertain terms." The BEA stand will cover 600 sq ft, and will be the first which visitors will see on entering the main building. It will outline the history of the corporation by means of photographs, diagrams, maps and models from the early post-war days of operating—at a loss—converted war-time aircraft from huts at Northolt, to becoming "Europe's foremost airline." Russian visitors will be able to follow BEA's record of seven consecutive years profitability; BEA made more than £2 million profit last year and carried more than 3½ million passengers.

The stand will also show how BEA pilots are trained, how passengers are looked after, and how meals are prepared and served. All the accompanying explanations will be in Russian, and two Russian-speaking BEA employees will be available.

BREVITIES

Sabena inaugurated 707 services between Brussels and Mexico City on December 2. Routing is via Montreal.

An airline merger is reported from Venezuela: LAV and Avensa are to be merged together as VIASA.

Japan Air Lines are to introduce tomorrow, December 10, reduced fares on all domestic routes. These are off-season rates, valid until February 28.

Next Monday, December 12, BOAC Boeing 707s will introduce a daily jet service between New York and Jamaica. From New York to Kingston via Montego Bay journey time will be about five hours in each direction.

The first five of the 15 Viscount 745Ds being returned by Capital Airlines are now in this country, and further batches will arrive at the beginning of next month and early in February. Five have already been bought by Alitalia.

The wreckage of the Philippine Air Lines' DC-3 which disappeared on November 23 with 33 people on board has been found on the thickly forested slope of Mount Baco, Mindoro Island, about 90 miles south of Manila. There were no signs of life.

The British Standards Institution announces that the *British Standard Guide* has been revised to cover international aerodrome lighting. Published with the approval of the MoA, copies may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London W1, price 12s 6d. (Postage extra to non-subscribers.)

It is reported that a new international airport is to be built near the town of Domodedovo, near Moscow. Millions of tons of earth have, it is said, been shifted in the course of levelling surrounding hills, and the site has an advantage in that its airspace does not conflict with that of the other Moscow airports of Vnukovo, Sheremetievo and Bykovo.

The appointment is announced of Mr F. H. J. Denning as production manager, spares, for Vickers-Armstrongs (Aircraft) Ltd. This is a new post. A centralized Viscount spares store is planned, together with streamlined procedures for the ordering and production of spares. Mr Denning, who is 40, has been with Vickers since 1939, and since 1956 he has been an assistant production manager.

A provisional Ministry of Aviation estimate shows that UK airline traffic on scheduled and inclusive tour services in October was 42 million ton-miles, an increase of 19 per cent compared with October 1959. Load factor fell from 61 per cent to 60 per cent. During the first ten months of 1960 traffic was 429 million ton-miles, an increase of 18½ per cent compared with the corresponding first ten months of 1959.

Sir Percy Hunting, chairman of the Hunting Group (left) is retiring on December 31. He is succeeded by his brother Mr G. L. Hunting (right) the present vice-chairman. Sir Percy's son, Mr Pat Hunting, becomes vice-chairman of the Hunting group of companies

Flying over Wisley on the eve of being granted its full certificate of airworthiness one of the first of 23 TCA V.952 Vanguards, CF-TKB. A sister - ship, CF-TKD, was due to have been handed over to the Canadian airline by the time this issue appeared. Likewise BEA were also due to have received their first fully certificated aircraft. A note appears below

AIR COMMERCE . . .

VANGUARD STARTS WORK

LAST Friday, December 2, the manager of BEA's Vanguard flight, Capt A. S. Johnson, was handed the flight manual of Vickers V.951 Vanguard G-APEE at Wisley. This event signified full ARB certification of the aircraft, and the start of the Vanguard's working career. As this issue went to press the first TCA V.952, CF-TKD, was also due to be certificated and to be handed over to the Canadian carrier.

BEA's Vanguard was immediately flown to Stansted where crew refresher-training began. The corporation plans to carry its first Vanguard passengers—on the London to Paris route supplementing Viscount capacity during the pre-Christmas rush—on December 17.

It is understood that the initial overhaul life of the Rolls-Royce Tyne, which emerged satisfactorily from the strip and inspection that followed the intensive 250hr engine assurance flying programme (*Flight*, November 4, page 695), will be 300hr.

While March 1 is BEA's date for the inauguration of their *full* Vanguard timetable, TCA are planning on February 1. Four senior TCA captains have been doing their conversions at Wisley, though the major part of the fleet training programme will be based on Montreal. On February 1 a daily transcontinental service between Montreal and Vancouver via Toronto, Winnipeg, Regina and Calgary will be started, together with a service from Toronto to Vancouver via Winnipeg, Saskatoon and Edmonton. A fortnight later, on February 15, Vanguards will inaugurate TCA services to the Atlantic provinces; on March 1 operations to eight different points in the Caribbean will begin. On April 1 services to the Atlantic provinces will be stepped up, and on April 30 a trans-border service from Toronto to Chicago will be introduced. The trans-border schedule will be stepped up on May 15 with a thrice-weekly service from Toronto to New York, and on June 1 with a four-times-weekly service from Montreal to New York. The transcontinental service will be stepped up on June 15 and on July 1 more Vanguards will be deployed in the Atlantic provinces.

It is understood that six Vanguards will be delivered to BEA and TCA before the end of this month, with the bulk of outstanding deliveries (20 aircraft for BEA and 23 for TCA) during 1961. The programme will be completed, on the basis of present orders, early in 1962.

Though the Vanguard programme is some eight months behind schedule, the aircraft goes into service within two years of its maiden flight; the Viscount V.630 prototype carried fare-paying passengers just about exactly two years after its maiden flight in July 1948, and the production V.700 Viscount went into service in April 1953, two years and eight months after its first flight.

FROM DART TO SPEY

ON November 30 Mr J. D. Pearson, chief executive and deputy chairman of Rolls-Royce, announced that 1,009 civil transport aircraft had been ordered with Rolls-Royce turbine engines —the thousandth sale having been made about a month before. Roughly 1,760 turbine airliners had been ordered in the western world, so that the Derby company's share was almost 60 per cent. Of the 1,009 aircraft, 621 were British-built, 192 American, 94 French, 85 Dutch and 17 Canadian.

Most of these aircraft—680 in all—are powered by the Dart turboprop, versions of which are now in service at the unparalleled overhaul life of 3,000hr. Avon turbojets account for 149 Comets and Caravelles, and according to Mr Pearson it has proved "even more reliable than the Dart." Current overhaul life is 2,300hr. Conway by-pass engines have so far been specified for 96 airliners, and although currently experiencing some teething troubles (remedies for all of which have been introduced) was currently on a 1,200hr basis, some having flown 1,350hr without attention. The Tyne, possibly the most complex type of engine the company will ever have to tackle, was going into 60 transports, and Rolls-Royce believed they had solved the problems which assailed it earlier in the year. Finally, the fully optimized Rolls-Royce Spey, which until Mr Pearson's address had been known only as the RB.163, was the powerplant of the de Havilland D.H.121 Trident, 24 of which were on order for BEA.

Among points made by Mr Pearson was that the company's need for some measure of Government support was becoming pressing. In the past, commercial engines had stemmed from military units, and the cost of development had not been amortized against civil sales. What Rolls-Royce would like to see would be for a share of the development cost—roughly £20m per engine—of large airline powerplants to be met by the Government, with repayment made from the start of sales. He would, he said, like to see support comparable to that enjoyed by Pratt & Whitney, and suggested that the sharing of development cost on a fifty-fifty basis would be very satisfactory. Technically, it was a compliment to Rolls-Royce that Pratt & Whitney, in designing an engine for the Boeing 727, had adopted "almost exactly the same technical specification as the Spey as regards by-pass ratio and compression ratio." But the fact remained that American operators had, not unexpectedly, chosen the American engine, so that Rolls-Royce's discussions with General Motors with a view to production of the Spey by Allison were now dead.

BUSY COMETS

UTILIZATION of BOAC's 19 Comet 4s is now averaging nearly 10½hr per day, and Aerolineas Argentinas are regularly achieving more than 9½hr a day with each of their four Comet 4s. These Comets recently had their Check 4 life of 3,000hr extended to a yearly basis, representing 3,600hr or more.

Mexicana, add D.H., are regularly achieving more than 8hr per day with two Comet 4Cs (a third has recently been delivered). EAAC's two Comet 4s are already averaging between 7 and 8hr a day, having entered service in September.

BEA's Comet 4B utilization is not so high, because of the relatively short-haul nature of their operations; it averages 6.4hr per day. Whilst a BOAC Comet makes one landing every 3.5hr a BEA Comet 4B lands every 1.7 flying hours. Olympic Airways, who operate Comet 4Bs in a consortium with BEA, are achieving similar utilizations.

The record of the Comet 4's Rolls-Royce Avon engines has, say DH, been "outstanding." Overhaul life is now up to 2,300hr (see previous note on this page), and the rate of unscheduled engine change has averaged less than 0.4 per 1,000 engine hours. A large proportion of such engine changes as have been necessary, say de Havilland, have been the result of bird ingestion.

XEROX